

## DOCUMENT RESUME

ED 170 578

CE 021 407

AUTHOR Katz, Douglas S.; Oglesby, Elizabeth H.  
TITLE A Manual of Competency Matched Instructional Materials for Developing Coal Mining Curricula.  
INSTITUTION Conserva, Inc., Raleigh, N.C.  
SPONS AGENCY Illinois State Office of Education, Springfield. Div. of Adult Vocational and Technical Education.  
PUB DATE Jan 79  
NOTE 52p.; Titles of books, which are given in italics, may not reproduce well  
EDRS PRICE MF01/PC03 Plus Postage.  
DESCRIPTORS \*Curriculum Development; Employment Qualifications; Entry Workers; Instructional Materials; \*Job Skills; \*Material Development; \*Performance Based Education; \*Performance Criteria; Resource Guides; \*Resource Materials; Secondary Education; Skill Development  
IDENTIFIERS \*Coal Mining; Illinois

## ABSTRACT

To assist in the development of secondary level coal mining curricula, this report identifies sixty-four competencies considered by coal mining companies and instructors to be of major or moderate importance. Also, four tables are used to aid curriculum planners. Table 1 contains occupational competencies ranked in importance for the secondary level coal mining curriculum; the instructional level is also included. Table 2 lists occupational competencies matched to available instructional resources, and table 3 presents an inventory of available instructional training resources matched to the coal mining competencies (knowledges and skills) which they cover. Table 4 inventories available instructional resources by source, title, author, description, and price. Following the tables are four procedural steps for curriculum planners: (1) identify competencies for inclusion in the coal mining curriculum; (2) identify instructional materials available for use in teaching the competencies selected in step 1; (3) match instructional/training materials to competencies to determine materials best suited for teaching competencies identified in step 1; and (4) make final selection of instructional/training materials to be used in the secondary level coal mining curriculum for entry-level miners.  
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# A MANUAL OF COMPETENCY MATCHED INSTRUCTIONAL MATERIALS FOR DEVELOPING COAL MINING CURRICULA

*Final Project Report  
RD1-C9-170*

Douglas S. Katz

Elizabeth H. Oglesby

CONSERVA, Incorporated  
431 Oberlin Road  
Raleigh, North Carolina

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
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## ACKNOWLEDGEMENTS

CONSERVA, Inc. is indebted to numerous individuals and organizations who contributed freely of their time and expertise to aid project efforts. In particular, we would like to express our sincere appreciation to the group of project technical advisors who completed the instrument rating occupational competencies as to their importance for entry-level coal miner training at the secondary level. This group of advisors included: Mr. Joseph Spivey, President, Illinois Coal Operators' Association; Mr. Brad Evilsizer, Director, Illinois Department of Mines and Minerals; Mr. James E. Long, Governor's Office of Manpower and Human Development, State of Illinois; Mr. James Spiller, Training Coordinator, Old Ben Coal Company, Benton, Illinois; Mr. Robert Gregg, Dean of Technology, and two unidentified mining instructors, Southeastern Illinois College; Mr. Dale F. Mason, Chairman, Mining Technology Department, Rend Lake College, Ina, Illinois; Mr. Dale Stretch, Assistant Superintendent of Vocational Education, Hillsboro Illinois Community Unit #3; Mr. Thomas L. Savage, Program Leader, West Virginia University Mining Extension Service, Morgantown; Mr. William Cupples, West Virginia University Visiting Professor, Technology Education; Mr. Frank Kozak, Publisher, Coal Mine Training, Inc., Charleston, West Virginia; Mr. George Pudlo, Director of Employee Development, Consolidation Coal Company, Pittsburgh, Pennsylvania; and Mr. Myles E. Altimus, Jr., American Electric Power Service Corporation, Lancaster, Ohio.

Others deserving special thanks include Dr. James Rosebrook, Supervisor, Industrial/Technical Education-Vocational Education, West Virginia State Department of Education, for coal miner training materials and referrals to individuals knowledgeable of coal mining; Mr. William Cupples for sharing information concerning coal mining materials and providing an opportunity for previewing of films relevant to the study; Ms. Elizabeth Kraft, National Coal Association, for information, materials, referrals to knowledgeable individuals and permission for access to the Association library; MESA (now MSHA) personnel at the National Mine Health and Safety Academy at Beckley, West Virginia; staff members of State Bureaus (or Departments) of Mines and State Geological Surveys; U.S. Bureau of Mines personnel; University faculty and staff members at Penn State and West Virginia University; State vocational education staff members and numerous directors and instructors of secondary and post-secondary coal mining programs in West Virginia, Pennsylvania, Kentucky, and Ohio.

Without the help of these individuals and agencies and others too numerous to mention, our project efforts would have been more difficult and less productive.

Finally, we would like to express a special word of appreciation to our project monitor, Mr. Charles Schickner, for his professional guidance and counsel throughout the duration of the project.

## INTRODUCTION

Illinois is rich with coal. In 1975 it was estimated that identified coal resources in Illinois were in excess of 160 billion tons, of which 45% were recoverable by 1974 mining methods (Malhotra and Simon, 1976). Approximately 81% of Illinois coal reserves are minable by underground methods and 19% by surface-mining methods. Among all the states, Illinois ranks second (after Montana) in coal reserves which are known to be recoverable using existing mining methods, and first in coal reserves which are recoverable using underground mining methods (U.S. Bureau of Mines, Information Circular 8680). Figure 1 shows the distribution of coal resources and reserves.

While the production of coal in the United States has increased in recent years, the Clean Air Act of 1970 has reduced the demand for high-sulfur coal such as that which predominates in Illinois. Nevertheless, in 1974 the Federal Energy Administration estimated that coal production in Illinois would increase by about 40 to 50 percent between 1975 and 1985, and in 1976 the Illinois State Geological Survey projected that coal production in Illinois will increase by approximately 56 percent between 1975 and 1985, as shown in Figure 2. To increase production at that rate, Drewes (1977) estimated that a coal mining labor force of approximately 19,185 will be required by 1985, (Figure 3). Of this number, he estimates that approximately 8,000 will be new hires into the coal mining industry, with 5,600 due to growth requirements and 2,400 due to replacement needs (Drewes, *op. cit.*).

### **A Role for Secondary Level Vocational Education in Coal Miner Training in Illinois**

This need for increased numbers of miners can be expected to exacerbate the already critical shortage of experienced mine workers. The implication for vocational education in Illinois is that approximately 800 persons annually will require entry level skills training plus additional numbers needing retraining for skills upgrading.

Currently, courses in coal mining leading to the Associate of Applied Science degree and the Certificate of Completion are offered at three Illinois Community Colleges—Southeastern Illinois College, Rend Lake College and Wabash Valley College. With the exception of one vocational program in land reclamation, no coal mining curriculum is offered at the secondary level.

Although there is ample justification for the lead role of post-secondary institutions in the training of skilled underground coal mining production workers, technicians and supervisory and management personnel, there is a concomitant justification for coal mining curricula at the secondary level. Post-secondary education is not a prerequisite for entry into coal mining occupations. This traditionally unionized industry recruits most new miners into the lower skilled occupations but offers considerable opportunity for advancement into positions requiring technological skills. The days of the pick and shovel have been replaced by continuous mining machines, Airdox breaking of coal, roof bolting machines, etc. Both men and women are being recruited who have the desire and technological orientation necessary to become highly productive coal miners.

Many youths who choose to seek employment upon completion of high school are presently not offered the opportunity for public school pre-employment entry skills training for coal mining careers. Data collected from mine personnel officers in Illinois indicate that high school graduates with relevant training would be given preferred hiring status over other inexperienced applicants with no formal training in coal mining.

A coal mining curriculum at the secondary level could complement post-secondary program offerings. Illinois citizens of all ages would then be provided access to a comprehensive public education system capable of developing coal mining skills ranging from entry level competencies to the most advanced technical, engineering and managerial competencies.

The projected demand for new hires in the Illinois underground coal mining industry within the coming years provides secondary vocational education with an opportunity and a challenge. **Vocational education can contribute substantially to the provision of training for the majority of those who will be hired as entry-level miners.** The challenge is that the requisite secondary level coal mining curricula must be developed quickly, yet carefully in order to include those competencies called for in entry-level coal mining positions.

### **Entry Level Coal Mining Competencies Identified**

In recognition of this apparent need for secondary level coal mining curricula, the Illinois Office of Education, Department of Adult, Vocational and Technical Education, awarded a contract to CONSERVA, Inc., to identify

the competencies which could be included in secondary level coal mining curricula. Once identified, the competencies would be matched to available instruction/training resources, so that local education agencies would be able to develop their own competency-based coal mining curricula tailored to their local needs and resources.

Pursuant to that contract CONSERVA, Inc., identified 64 competencies which were considered by coal mining companies and instructors to be of major or moderate importance for inclusion in a secondary level curriculum. Each competency was subsequently matched to available instructional resources (films, textbooks, workbooks, etc.), resulting in a prioritized list of competencies matched to relevant instructional materials. Samples of

the instructional resources were purchased by CONSERVA and submitted to DAVTE for review and use by local school personnel interested in establishing a coal mining curriculum.

The prioritized list of competencies matched to instructional resources is intended to serve as the basis for local coal mining curriculum planning and development. In comparison to a fully developed curriculum, it offers local educational agencies greater flexibility in planning a curriculum that is best suited to their particular financial and personnel resources. It can be incorporated into curricula of different durations, and can be easily adapted to the specific needs of local coal mining operations.

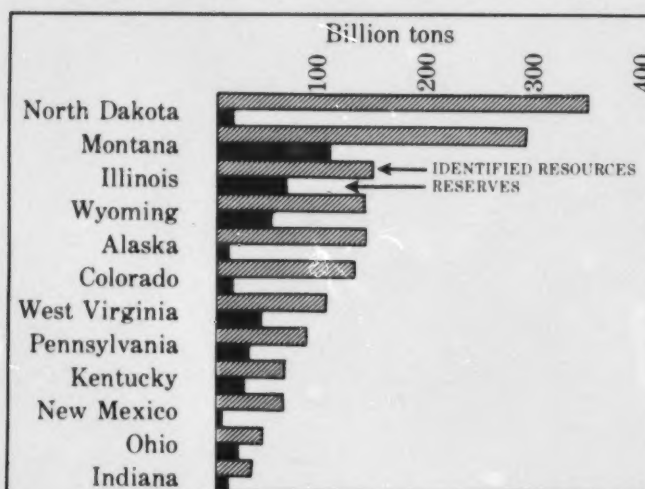


Figure 1. Distribution of identified coal resources and reserves in the 12 leading states. (Source of data: Averitt, 1975.)

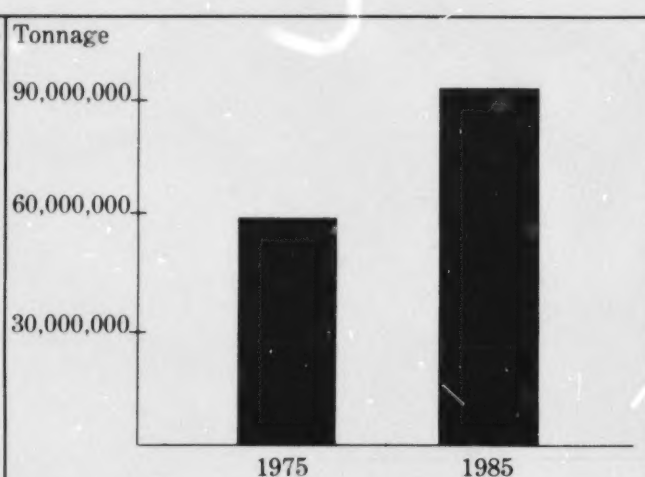


Figure 2. Coal Production in Illinois. From an annual tonnage of 59,537,000 in 1975 to 93,000,000 in 1985 — an increase of fifty-six percent.

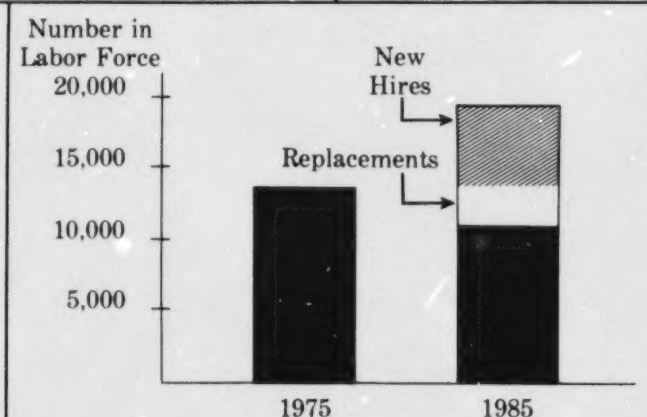


Figure 3. Coal Mining Labor Force in Illinois. From a coal mining labor force of 13,646 in 1975 to 18,185 in 1985 — an increase of over forty percent.

## PRODUCTS

Four tables have been developed to aid planners of secondary level underground coal mining curricula. The tables are:

- Table I. Occupational Competencies Ranked in Order of Their Importance for Inclusion in a Secondary Level Coal Mining Curriculum
- Table II. Occupational Competencies Matched to Available Instructional Resources
- Table III. Inventory of Available Instructional/Training Resources Matched to the Coal Mining Competencies Which They Cover
- Table IV. Inventory of Available Instructional Resources by Source

Each of the tables is described briefly below. A four-step procedure for their use in the planning of secondary level coal mining curricula is outlined in the following section of this manual beginning on page 44.

**Occupational competencies** as defined in the study include those **knowledges**, **understandings**, **skills**, and **abilities** that could potentially be offered in coal mining curricula at the secondary level. The competencies would be offered for the preparation of students for entry-level positions in the coal mining industry.

**Knowledges** show an awareness of factual material such as the major methods of underground coal mining, federal and state mining laws, etc. **Understandings** are based on the knowledge of causes underlying happenings, practices or procedures, e.g., understanding of principal causes of mine fires and explosions, understanding of the physical principles of roof control systems. **Skills** and **abilities** pertain to developed levels of manipulative performance or demonstration of behaviors, e.g., able to construct ventilation structures, able to demonstrate good attitudes and work habits, etc.

**Table 1**  
**Occupational Competencies Ranked in Order of Their Importance for Inclusion in a Secondary Level Coal Mining Curriculum**

Table 1 shows the listing of occupational competencies ranked in order of their importance for inclusion in a secondary level coal mining curriculum.

Importance ratings were assigned by a panel of technical advisors using the following scale:

- 1 — Little or no importance;
- 2 — Of moderate importance; and
- 3 — Of major importance for entry-level coal mining.

Competencies were also rated by the panel according to whether basic introductory instruction or in-depth instruction was needed.

The first column of Table I lists the mean importance ranking for each competency. The second column shows the mean responses to the level of instruction needed. The higher the mean, the more in-depth instruction is judged to be required.

The occupational competencies are organized into **two basic types**. The **first type** includes **knowledges** and **understandings** which are of potential importance to entry-level miners and which can be learned primarily in a classroom or lab situation. The **second type** consists of **abilities** or **skills** which in many cases require the application of knowledges and understandings of a subject to specific job tasks. The numerals in parentheses following each competency statement in Table I refer to the Section and number location of that competency in Table II.

Table I contains competencies as described in both Section I and Section II of Table II. The fact that both types of competencies are included in Table I accounts for the apparent similarity between certain statements. For instance, competency statement Number 41 of Section I, Table II, concerns the *knowledge and understanding of the fundamentals of First Aid treatment* in various types of medical emergencies. Competency statement Number 16 of Section II, involves the *ability to administer correct First Aid treatment* in various types of medical emergencies — i.e., the demonstration or practical application of a skill involving the earlier knowledges and understandings. All Abilities/Skills statements from Section II can be identified by the introductory phrase, 'Able to. . . .'

As a starting point for curriculum planning, Table I presents a number of competencies deemed important for inclusion in a secondary level coal mining curriculum. A discussion of the further use of the competency statements in the planning of a coal mining curriculum is presented in the Procedures for Use section of this manual.

**Table I. Occupational Competencies Ranked in Order  
of Importance for Inclusion in a Secondary Level Coal Mining Curriculum**

| <b>Importance<br/>Rating*</b>                                                           | <b>Level of<br/>Instruction**</b> | <b>Competencies Rated as Being "Of Major Importance" for Entry-Level Coal Miners</b>                                                                                        |
|-----------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.00                                                                                    | 2.09                              | Able to demonstrate good attitudes and work habits such as proper care of tools and equipment, regular and punctual attendance, job motivation and initiative, etc. (II, 5) |
| 3.00                                                                                    | 2.33                              | Able to use and care for personal equipment correctly and safely. (II, 18)                                                                                                  |
| 2.92                                                                                    | 2.67                              | Methods used in the prevention of mine fires and explosions. (I, 37)                                                                                                        |
| 2.92                                                                                    | 2.67                              | Uses and requirements of personal mine safety equipment. (I, 43)                                                                                                            |
| 2.92                                                                                    | 1.80                              | Able to follow oral and written directions effectively. (II, 3)                                                                                                             |
| 2.92                                                                                    | 1.83                              | Able to work cooperatively with others. (II, 4)                                                                                                                             |
| 2.92                                                                                    | 2.17                              | Able to use instruments, hand tools, power tools, and equipment properly and safely. (II, 21)                                                                               |
| 2.92                                                                                    | 2.50                              | Able to administer correct First Aid treatment in various types of medical emergencies — accidents, fires, explosions, heart attacks, etc. (II, 16)                         |
| 2.91                                                                                    | 2.09                              | Able to demonstrate correct procedures for escape or self-rescue in case of fire or explosions. (II, 20)                                                                    |
| 2.83                                                                                    | 2.50                              | Principal causes of mine fires and explosions. (I, 35)                                                                                                                      |
| 2.83                                                                                    | 2.09                              | Able to perform various types of lubrication jobs (gear box, bearings, oiling of conveyor chains, etc.) using proper lubricants and equipment. (II, 40)                     |
| 2.83                                                                                    | 2.17                              | Able to recognize and avoid hazards caused by unsafe mine conditions, mine machinery, electrical or other equipment, defective tools, etc. (II, 17)                         |
| 2.83                                                                                    | 2.67                              | Fundamentals of First-Aid for various types of medical emergencies — accidents, fires, heart attacks, electrical shock, etc. (I, 41)                                        |
| 2.75                                                                                    | 2.33                              | General health and safety procedures and practices in the mines. (I, 42)                                                                                                    |
| 2.75                                                                                    | 2.33                              | Safe and proper use and care of instruments, hand tools, power tools and equipment. (I, 45)                                                                                 |
| 2.75                                                                                    | 2.17                              | Basic coal mining terminology. (I, 2)                                                                                                                                       |
| 2.75                                                                                    | 2.17                              | Basic procedures for roof and rib control. (I, 32)                                                                                                                          |
| 2.75                                                                                    | 2.17                              | Visual and auditory cues denoting hazardous roof and rib conditions. (I, 33)                                                                                                |
| 2.75                                                                                    | 1.91                              | Able to demonstrate procedures and techniques which serve to prevent the occurrence of mine fires or explosions. (II, 13)                                                   |
| 2.75                                                                                    | 2.33                              | Mining laws, regulations, health and safety codes (Federal, State). (I, 12)                                                                                                 |
| 2.73                                                                                    | 2.27                              | Local company policies, procedures, rules and regulations. (I, 13)                                                                                                          |
| 2.67                                                                                    | 2.17                              | Appropriate methods of testing roofs and roof structures. (I, 34)                                                                                                           |
| 2.67                                                                                    | 2.27                              | Physical principles of roof control systems for various types of roof conditions. (I, 31)                                                                                   |
| 2.64                                                                                    | 2.40                              | The management and labor structure of the coal mining industry (or a mining company or a typical mine). (I, 9)                                                              |
| 2.58                                                                                    | 2.09                              | Occupational and job opportunities in the coal mining industry. (I, 1)                                                                                                      |
| 2.58                                                                                    | 1.91                              | Able to test roof using proper procedures, visual and auditory cues, testing rods or other equipment. (II, 12)                                                              |
| 2.58                                                                                    | 2.43                              | Methods of detecting mine gases and gas detection instruments. (I, 24)                                                                                                      |
| 2.50                                                                                    | 2.09                              | Hazards and physiological effects associated with specific gases, combinations of gases, and/or deficiency of gas(es); mine damp. (I, 23)                                   |
| 2.50                                                                                    | 2.09                              | Explosion hazards and safety precautions during blasting. (I, 40)                                                                                                           |
| 2.50                                                                                    | 2.00                              | Combustibility or ability of gases to support combustion. (I, 22)                                                                                                           |
| <b>Competencies Rated as Being "Of Moderate Importance" for Entry-Level Coal Miners</b> |                                   |                                                                                                                                                                             |
| 2.45                                                                                    | 1.89                              | Able to demonstrate correct basic roof and rib control construction and installation practices and procedures. (II, 11)                                                     |
| 2.42                                                                                    | 1.36                              | Able to demonstrate proper fire fighting techniques for controlling mine fires. (II, 14)                                                                                    |

\*3.00 = Of Major Importance; 2.00 = Of Moderate Importance; 1.00 = Of Little or No Importance

\*\*3.00 = In-Depth Instruction; 1.00 = Introductory Instruction

Table I — continued

| Importance Rating* | Level of Instruction** | Competencies Related as Being "Of Moderate Importance" for Entry-Level Coal Miners                                                                                                                                                  |
|--------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.42               | 1.91                   | UMWA and the current National Bituminous Coal Wage Agreement. (I, 10)                                                                                                                                                               |
| 2.42               | 1.91                   | Types of mines (shaft, drift and slope) and their characteristics. (I, 14)                                                                                                                                                          |
| 2.42               | 1.83                   | Mine ventilation maps — symbols and definitions. (I, 28)                                                                                                                                                                            |
| 2.42               | 1.80                   | Physical properties of mine gases such as elasticity, weight, density, specific gravity, color, odor, taste, etc. (I, 17)                                                                                                           |
| 2.42               | 1.67                   | Mine ventilation systems and their components. (I, 27)                                                                                                                                                                              |
| 2.42               | 1.66                   | Basic terminology applying to haulage and haulageway equipment. (I, 46)                                                                                                                                                             |
| 2.36               | 1.89                   | Able to demonstrate proper procedures and practices for mine rescue in various emergency situations such as fires, explosions, roof falls, etc. (II, 19)                                                                            |
| 2.33               | 1.18                   | Able to demonstrate proper safety precautions to be taken during blasting in mines. (II, 15)                                                                                                                                        |
| 2.33               | 2.20                   | Safest and most effective methods of fighting mine fires. (I, 38)                                                                                                                                                                   |
| 2.33               | 2.17                   | Environmental effects of coal production and use. (I, 7)                                                                                                                                                                            |
| 2.33               | 2.00                   | The uses of explosives and blasting procedures used in coal mining. (I, 39)                                                                                                                                                         |
| 2.33               | 1.67                   | The major methods of underground and surface coal extraction, preparation and transportation. (I, 15)                                                                                                                               |
| 2.33               | 1.17                   | Equipment, methods and practices used in the transportation of coal. (I, 47)                                                                                                                                                        |
| 2.25               | 1.36                   | Able to construct ventilation structures such as brattice and tubing, masonry and metal stoppings and overcasts. (II, 10)                                                                                                           |
| 2.25               | 1.91                   | Land reclamation laws, rules and regulations. (I, 8)                                                                                                                                                                                |
| 2.25               | 2.11                   | Able to make minor adjustments or repairs to mining machinery and equipment. (II, 36)                                                                                                                                               |
| 2.25               | 1.33                   | The uses of coal — present and future — and the forms in which coal is used. (I, 6)                                                                                                                                                 |
| 2.25               | 1.33                   | Construction and component parts of ventilation systems. (I, 30)                                                                                                                                                                    |
| 2.18               | 1.89                   | Functions of the major pieces of mining machinery and equipment such as: universal cutting machine, face drill, loading machine, shuttle car, roof bolter, continuous miner, conveyor, locomotive, trolley, dump and scoop. (I, 64) |
| 2.17               | 1.44                   | Able to recognize and take proper safety measures to escape or correct hazardous mine conditions (including mine damp) caused by gases. (II, 8)                                                                                     |
| 2.17               | 1.89                   | Able to detect and identify mine gases either by their physical properties (color, taste, etc.) or by using the flame safety lamp, the permissible methane spotter, bulb-type gas detectors or other methods. (II, 7)               |
| 2.17               | 1.75                   | Chemical reactions resulting from mine fires and explosions. (I, 36)                                                                                                                                                                |
| 2.17               | 1.80                   | Governmental agencies (National, State, local) that are concerned with the mining industry. (I, 11)                                                                                                                                 |
| 2.17               | 1.60                   | Velocity of air and mine resistance to an air current. (I, 29)                                                                                                                                                                      |
| 2.17               | 1.36                   | The technical development of the coal industry, including its impact on the U.S. and the State economy. (I, 4)                                                                                                                      |
| 2.17               | 1.22                   | Effects of temperature and pressure on gases. (I, 18)                                                                                                                                                                               |
| 2.08               | 1.89                   | Fundamentals of machines used in underground mining and transportation of coal — their construction, procedures for operation and maintenance. (I, 62)                                                                              |
| 2.00               | 1.29                   | Able to maintain track and trolleys in a safe manner. (II, 24)                                                                                                                                                                      |
| 2.00               | 1.60                   | Able to read and demonstrate comprehension of technical material, maps, drawings, etc. related to coal mining activities. (II, 1)                                                                                                   |
| 2.00               | 1.44                   | Mine rescue training. (I, 44)                                                                                                                                                                                                       |
| 2.00               | 1.40                   | Chemical composition of air in the mines. (I, 21)                                                                                                                                                                                   |
| 2.00               | 1.18                   | Need for and methods of water control in coal mines. (I, 61)                                                                                                                                                                        |

\*3.00 = Of Major Importance; 2.00 = Of Moderate Importance; 1.00 = Of Little or No Importance

\*\*3.00 = In-Depth Instruction; 1.00 = Introductory Instruction

Table I — continued

| Importance Rating* | Level of Instruction** | Competencies Rated as Being "Of Little or No Importance" for Entry-Level Coal Miners                                                                                                                                                                                             |
|--------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.92               | 1.89                   | Atmospheric pressure and its effects on mine ventilation requirements. (I, 26)                                                                                                                                                                                                   |
| 1.92               | 1.50                   | Sampling and analysis of mine air. (I, 25)                                                                                                                                                                                                                                       |
| 1.91               | 1.50                   | Lubrication — types of lubricants, lubricating equipment, lubricating charts, lubricating checks and inspections; procedures for lubrication of gear boxes, bearings, grease cups, etc.; oiling of conveyor chains; freeing of frozen rollers; packing of bearings, etc. (I, 67) |
| 1.91               | 1.22                   | The history and growth of coal mining as an industry. (I, 3)                                                                                                                                                                                                                     |
| 1.83               | 1.00                   | Able to design a ventilation system in a model mine, demonstrating ventilation structures and the use of ventilation maps. (II, 9)                                                                                                                                               |
| 1.83               | 1.57                   | Able to lay track properly. (II, 23)                                                                                                                                                                                                                                             |
| 1.83               | 2.00                   | Able to solve mathematics problems in coal mining activities, such as determining percentage of mine gases; calculating volume of gases, liquids, and solids; measurement of temperature, pressure, area, weight and distance, velocity of air; power calculations, etc. (II, 6) |
| 1.83               | 2.00                   | Able to prepare a roadbed for transportation equipment used in the mining of coal. (II, 22)                                                                                                                                                                                      |
| 1.83               | 2.00                   | Able to install, remove and/or replace mining machinery or equipment parts such as bearings, gears coupling and drive shafts, belts, etc. (II, 42)                                                                                                                               |
| 1.83               | 1.50                   | Moisture content of air and its implications in coal mining; solubility of gases in water. (I, 20)                                                                                                                                                                               |
| 1.83               | 1.22                   | The geology of coal and ores (or carbon fuels). (I, 5)                                                                                                                                                                                                                           |
| 1.75               | 2.00                   | Able to operate the major pieces of mining machinery and equipment such as universal cutting machine, face drill, loading machine, shuttle car, roof bolter, continuous miner, conveyor, locomotive, trolley, dump and scoop. (II, 35)                                           |
| 1.75               | 1.80                   | Able to perform arc or oxy-acetylene welding, or MIG or TIG where required for mine machinery and equipment repair, construction or maintenance of mine structures or systems. (II, 38)                                                                                          |
| 1.75               | 1.25                   | Diffusion of gases (Graham's Law); occlusion and absorption. (I, 19)                                                                                                                                                                                                             |
| 1.67               | 1.40                   | Able to install, maintain, remove and/or replace electrical switches, motors, cables, lines, lights, transformers, etc. (II, 39)                                                                                                                                                 |
| 1.67               | 1.80                   | Able to install, maintain or repair mechanical power transmission systems as used in underground coal mining. (II, 37)                                                                                                                                                           |
| 1.67               | 2.00                   | Able to install piping for mine water removal. (II, 34)                                                                                                                                                                                                                          |
| 1.67               | 2.00                   | Able to diagnose and correct mechanical malfunctions in mining machinery and equipment. (II, 41)                                                                                                                                                                                 |
| 1.67               | 1.67                   | Applied mathematics including topics such as basic functions (addition, subtraction, multiplication, division) fractions, decimals, percentage, measurement and units of measure, ratio and proportion, area and volume. (I, 16)                                                 |
| 1.67               | 1.25                   | Hydraulic power transmission — pipe, tube and hose conductors; physical properties, friction. (I, 57)                                                                                                                                                                            |
| 1.64               | 2.00                   | Mechanics — procedures for installation, operation, maintenance, repair and replacement of parts of mining machinery including bearings, oil seals, gears, coupling and drive shafts, sprockets and chains, conveyors, etc. (I, 69)                                              |
| 1.58               | 1.80                   | Able to diagnose and correct malfunctions in electrical components of mining machinery and equipment. (II, 26)                                                                                                                                                                   |
| 1.58               | 1.80                   | Able to use schematic drawings in installation, maintenance or repair of mine electrical systems, motors or components. (II, 27)                                                                                                                                                 |
| 1.58               | 1.80                   | Able to install, maintain, or repair electrical power transmission systems as used in underground coal mines. (II, 28)                                                                                                                                                           |
| 1.58               | 1.80                   | Able to interpret and use drawings, orthographics or multiviews as used in the construction, operation, repair or maintenance of coal mining structures, machinery or equipment. (II, 29)                                                                                        |
| 1.58               | 1.80                   | Able to diagnose and correct malfunctions of mine hydraulic systems or components of coal mining machinery and equipment (i.e., cylinders, valves, pumps, controls). (II, 31)                                                                                                    |

\*3.00 = Of Major Importance; 2.00 = Of Moderate Importance; 1.00 = Of Little or No Importance

\*\*3.00 = In-Depth Instruction; 1.00 = Introductory Instruction

Table I — continued

| Importance Rating* | Level of Instruction** | Competencies Rated as Being "Of Little or No Importance" for Entry-Level Coal Miners                                                                                                                                                                                                          |
|--------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.58               | 1.80                   | Able to install and maintain pumps for mine water removal. (II, 33)                                                                                                                                                                                                                           |
| 1.58               | 1.80                   | Mine electrical power transmission — procedures involved in installation and maintenance of electrical power transmission systems as used in underground coal mines; application of mining laws to power transmission, safety ground systems, circuits and cable monitoring circuits. (I, 53) |
| 1.58               | 1.80                   | Hydraulic fluids — characteristics affecting performance of hydraulic systems; maintenance, storage and handling of hydraulic fluids. (I, 59)                                                                                                                                                 |
| 1.55               | 3.00                   | Welding — fundamental principles of welding (heliarc and oxy-acetylene, MIG and TIG, etc.) including equipment and capabilities of each type; uses in construction, maintenance or repair of mining machinery, equipment, structures or systems. (I, 68)                                      |
| 1.50               | 1.40                   | Able to interpret and accurately prepare written reports. (II, 2)                                                                                                                                                                                                                             |
| 1.50               | 1.00                   | Function and operation of hydraulic accessory equipment such as reservoirs, accumulators, filters, boosters, instruments, heat exchangers, etc. (II, 58)                                                                                                                                      |
| 1.50               | 2.00                   | Able to diagnose and correct malfunctions of pneumatic systems or components used in the mining or transporting of coal. (II, 43)                                                                                                                                                             |
| 1.50               | 2.00                   | Able to install and maintain pneumatic systems or pneumatic components of mining equipment and machinery. (II, 44)                                                                                                                                                                            |
| 1.50               | 1.00                   | Basic electrical terms, symbols and definitions. (I, 48)                                                                                                                                                                                                                                      |
| 1.45               | 1.00                   | Basic electrical theory including voltage, amperage and wattage and their measurements, resistance and line drops, series and parallel circuits, alternative and direct current electricity, magnetism, etc. (I, 49)                                                                          |
| 1.42               | 1.80                   | Able to apply knowledge of basic electrical theory, electrical circuits, motors, generators, controls, transformers, solid state systems, etc., to mining activities. (II, 25)                                                                                                                |
| 1.42               | 2.00                   | Able to install, maintain or repair hydraulic power transmission systems as used in underground coal mines. (II, 30)                                                                                                                                                                          |
| 1.42               | 1.50                   | Applications/uses of hydraulic power in coal mining including cylinders, valves, motors, pumps, controls and other components of a fluid power system. (I, 60)                                                                                                                                |
| 1.42               | 1.00                   | Basic terminology, symbols and definitions pertaining to hydraulics — hydraulic systems, fluid properties. (I, 54)                                                                                                                                                                            |
| 1.42               | 1.00                   | Basic principles of hydraulics (e.g., Pascal's Law); characteristics of fluids in motion; measurable pressures affecting liquid flow, etc. (I, 55)                                                                                                                                            |
| 1.36               | 2.00                   | Able to design a plan for mine water removal. (II, 32)                                                                                                                                                                                                                                        |
| 1.36               | 1.67                   | Graphics such as orthographics, multiviews and working drawings of mining machines and equipment (e.g. blueprints, three-view projections, skeleton views, exploded views, etc.) (I, 65)                                                                                                      |
| 1.36               | 1.00                   | Mechanical power transmission — functions of gears, coupling, drive shafts, belts, etc. (I, 63)                                                                                                                                                                                               |
| 1.36               | 1.00                   | Industrial electricity — procedures for installation, removal and/or replacement, operation of electrical switches, disconnect devices, cables, lines, lights, transformers, etc.; electric motors; power or control circuit wiring, communication systems, etc. (I, 66)                      |
| 1.33               | 1.67                   | Hydraulics — procedures for installation, operation, adjustment, repair and replacement of the hydraulic systems or components of machines used in the mining or transporting of coal. (I, 70)                                                                                                |
| 1.27               | 1.00                   | Schematic drawings of electrical circuits, electrical systems, components, etc. (I, 52)                                                                                                                                                                                                       |
| 1.18               | 1.00                   | Functions and applications of electrical circuits, generators, types of electrical controls, transformers, and solid state systems in coal mining. (I, 50)                                                                                                                                    |
| 1.18               | 1.00                   | Fundamental principles of construction and operation of electric motors as components of mining machinery and equipment. (I, 51)                                                                                                                                                              |
| 1.17               | 1.00                   | Hydraulic application of mechanics in fluid power; 1) work, pressure, acceleration, energy; 2) inertia, power, efficiency. (I, 56)                                                                                                                                                            |
| 1.08               | 1.00                   | Pneumatics — procedures for installation, operation, maintenance, repair and replacement of pneumatic systems or pneumatic components of machinery used in the mining or transporting of coal. (I, 71)                                                                                        |

\*3.00 = Of Major Importance; 2.00 = Of Moderate Importance; 1.00 = Of Little or No Importance

\*\*3.00 = In-Depth Instruction; 1.00 = Introductory Instruction

# # #

## Findings and Implications for Curriculum Planning

In order to facilitate understanding of the findings for the purposes of curriculum planning, the competencies are presented in three groupings: those rated as being 1) of major importance, 2) of moderate importance, and 3) of little or no importance for inclusion in secondary level coal mining curricula. The groupings were made by ranking the means of the importance ratings assigned to each competency by the technical advisors. Competencies with mean importance ratings falling within one of the three specific ranges are grouped together. Those competencies whose mean ratings were in a range from 2.50 to 3.00 were considered "Of Major Importance" and those competencies whose mean ratings ranged from 2.00 to 2.49 were considered "Of Moderate Importance" for entry-level miners. Competencies which received a mean rating of less than 2.00 were considered as being "Of Little or No Importance" for entry-level miners.

Examination of Table I indicates that competencies considered to be of **major importance** for entry-level miners include:

- 1) job supportive skills or attributes such as good work habits, attitudes, cooperation, etc.;
- 2) safety, including avoidance or prevention of accidents and proper reaction and response in case of emergencies;
- 3) proper and safe use and care of personal equipment and tools;
- 4) ability to perform various types of lubrication jobs;
- 5) understanding of basic coal mining terminology;
- 6) roof and rib control;
- 7) mining laws, rules and regulations at the Federal, State and local (or company) levels;
- 8) the management/labor structure of the coal mining industry, including job opportunities, and
- 9) mine gases, their identification, detection and associated hazards.

Competencies felt to be of **moderate importance** for entry-level miners include those involving:

- 1) mine ventilation, including mine maps;
- 2) technical development, methods, and economic impact of coal mining;
- 3) transportation (haulage) of coal;

- 4) minor adjustments or repairs to mining machinery and equipment; and
- 5) fundamentals and functions of major pieces of mining machinery and equipment.

Competencies judged as being of **little or no importance** for inclusion in secondary level coal mining curricula for entry-level miners include:

- 1) operation of major pieces of mining machinery and equipment;
- 2) basic terminology and principles of electricity, hydraulics, mechanics, and pneumatics;
- 3) use or understanding of graphics, schematics, etc., in the installation, repair, or maintenance of equipment and machinery;
- 4) diagnosis and correction of malfunctions in machinery and equipment;
- 5) welding;
- 6) installation and maintenance of pumps, etc.

These competencies require complex skills, machinery and equipment-intensive training and/or long periods of training and experience. In addition to the high skill levels and training required, jobs involving these skills are not generally available to entry-level miners because of the occupational structure outlined by union regulations.

### Competencies of Major Importance for Entry-Level Coal Miner Training at the Secondary Level.

Analysis of the occupational competencies rated as most important has interesting implications for curriculum development. In the estimation of respondents knowledgeable of coal mining and coal miner training programs, qualities such as good attitudes and work habits, ability to follow directions, cooperation with others, and proper and safe use of tools and equipment take precedence for entry-level miners over more specific knowledges and job skills. Rather than being a body of factual or cognitive information necessary for the performance of job duties and activities specific to the coal industry, these highly valued qualities are **general employability skills** underlying the ability of a student to function as an employee.\* The development of these important qualities may be encouraged and fostered 1) by the personal example of the instructor, 2) by the

\*For further information on this topic, see Nelson, R.E. *Methods and Materials for Teaching Occupational Survival Skills*, University of Illinois at Urbana-Champaign, 1978.

constant emphasis of the instructor upon the vital and sometimes critical nature of these qualities in the mining environment, and 3) by the insistence of the instructor that students exhibit good work habits, follow instructions, and practice care and safety with all tools and equipment in classroom/lab and shop activities.

The **subject of safety** is particularly important to coal miners and can be presented as an integral component of the coal mining curricula. Of twenty competencies that involve safety, thirteen received ratings "Of Major Importance" and seven received ratings "Of Moderate Importance" for entry-level miners. General overall safety procedures and practices in the mine can be taught as a separate unit of instruction, and specific aspects of safety which apply to each topic or unit of instruction can be integrated into the curriculum. The importance ratings emphasize the competencies involving the prevention of accidents through instruction in 1) the recognition and avoidance of hazards, 2) the major causes of accidents or emergencies in coal mining, 3) proper and safe use of tools, machinery, and equipment, and 4) the observance of Federal, State and local safety codes and regulations.

In addition to the teaching of **prevention or avoidance** of accidents or emergencies, emphasis was given to the importance of **proper reaction and response** in case emergencies or accidents do occur. Knowledge of correct First Aid treatment and the ability to administer it effectively are both very important to entry-level miners. If the training is given by a certified Red Cross instructor, a First Aid Certificate is awarded on completion of the course. This certificate, if presented to a coal miner employer within twelve months of the training period, is proof of the fulfillment of the mandated requirement for First Aid training.

Entry-level miners were felt to need instruction in the **proper use of personal safety equipment, procedures for escape or self-rescue** in case of mine fires, explosions, or other emergencies, and **techniques for fighting different classes of mine fires**, e.g., electrical, flammable liquids, etc. The instruction requires at least a minimum of actual personal coal mining safety equipment, mine maps for teaching of escapeways and airflow, materials for constructing a barricade, and if possible, several types of fire extinguishers for teaching fire fighting of the different kinds of fires.

**Using and caring for personal equipment, instruments, hand and power tools properly and safety** was considered one of the highest priorities for entry-level miners. Training in the use and care of self-rescue equipment is vital to the individual's safety in case of mine emergencies, and careful use and maintenance of instruments, hand and power tools can help to avoid accidents or prevent injuries both to the miner and his/her co-workers.<sup>1</sup> Use of the wrong tool for the job and

carelessness in leaving tools or equipment in the wrong place have caused numerous accidents and injuries to coal miners. It is important that special care be taken in the use of delicate instruments and hand or power tools. Mistreated instruments can give faulty readings, and poorly maintained or incorrectly used hand or power tools are potentially dangerous to the miner.

Entry-level miners are considered to need the **ability to perform various types of lubrication jobs**. The proper lubrication of mining machinery and equipment is an integral part of an overall preventive maintenance program. The coal mining environment with its problems of coal dust, rock dust, moisture and periods of intensive equipment use makes imperative a system of proper periodic lubrication in order to help avoid costly mechanical breakdowns and work stoppages.

**Knowledge and understanding of basic coal mining terminology** is a vital competency for entry-level miners. In order to be responsive to directions from supervisors, knowledgeable concerning their jobs, and safe workers, it is necessary that entry-level miners have an understanding of those terms which are basic and in some cases exclusive to the coal mining industry. The basic terminology of coal mining can be taught during an orientation portion of the coal mining curriculum, or specific terms concerning each unit of instruction (e.g., coal mine ventilation, mine gases, roof and rib control, etc.), can be introduced along with the relevant instructional material.

Another grouping of competencies considered important for entry-level miners concerns those involving **roof and rib control**. Knowledge of basic roof and rib control systems, the ability to detect hazardous roof and rib conditions, appropriate methods of testing roof and roof structures, and correct basic roof and rib control construction and installation procedures and practices are included in this topical group. Perhaps the reason for the high importance ratings assigned roof and rib control is the sobering statistic that falling roof and ribs kill more miners each year than any other single type of accident.<sup>2</sup>

Entry-level mining students in a classroom setting can be taught the importance of a correct roof and rib support system, the types and appearance of potentially dangerous roof faults (e.g., cracks, cleavage planes, kettle bottoms, etc.) and the proper methods, tools and procedures for testing and scaling of roof and ribs. The actual detection of hazardous roof and rib conditions through the time-honored sight, sound and vibration method can only be learned in an actual mine by experience, careful observation and judgment. Experience and judgment are based on knowledge of the characteristics of the roof of a particular coal mine and how it acts when exposed at various steps in the mining process.

<sup>1</sup>The hiring of both males and females as entry-level miners is mandated by federal law, and training programs are preparing both sexes in coal mining states such as Kentucky, Pennsylvania and West Virginia.

<sup>2</sup>U.S. Bureau of Mines Instruction Guide 17, Roof and Rib Control, p. 12.

It is of major importance for entry-level miners to be familiar with Federal and State mining laws, regulations and health and safety codes. A great number of these laws, regulations and codes were developed in order to make mines and the mining process safer and healthier for the worker. Ignorance of the law or disregard of it is a serious matter and can bring about work stoppages or in some cases the closing of the mine.

Local company policies, procedures, rules and regulations were also indicated as being knowledges for entry-level miners to acquire. Classroom training of mining students can make them aware of the types of local company information they should learn, e.g., supervisory line of authority, procedures for mine transportation and communication, the mine check-in and check-out system, mine escapeways and emergency evacuation procedures, information concerning payroll, annual and sick leave, causes for discharge, grievance procedures, etc. After the students are employed, they will receive federally mandated training in the specific policies and procedures applicable to the mines in which they will be working.

Knowledge of the management and labor structure of the coal mining industry, and occupational and job opportunities in coal mining are ranked as being of consequence for entry-level miners. These types of information lend themselves well to classroom instruction, and their presentation could be enhanced by having individuals such as a coal mine superintendent, a UMWA official, and a mine personnel director speak to the mining students on the particular topic relating to their work in the industry.

Competencies which are closely tied in to the subject of safety, but which are considered of concern in their own right, include those pertaining to mine gases — their identification and detection; the hazards and physiological effects of specific gases, their physical properties, and their combustibility or ability to support combustion. An abnormal (gas) condition can occur underground in a number of ways. Interruption of the ventilation air, sudden outbursts of gases from pockets between layers of coal or other strata, excessive mining rates, fires, and explosions can all precipitate dangerous gassy conditions. It is important that miners know emergency procedures to follow depending upon the gas(es) involved in order to prevent injury or the loss of life. Equally important, if not more so, is the need for miners to know preventive measures in order to avoid emergencies involving mine gases. Basic understandings of the characteristics of gases and the effects of temperature and pressure on mine gases can be vital to the prevention of those emergencies involving abnormal gassy conditions.

#### **Competencies of Moderate Importance for Entry-level Coal Miner Training at the Secondary Level.**

The closely associated competencies concerning mine gases, the knowledges and understandings of mine ventilation systems and their components, mine ventilation maps, including their symbols and definitions, and the ability to construct mine ventilation structures were deemed of moderate importance for entry-level miners. In addition to a study of the dangers of mine gases, the purposes of mine ventilation in removing harmful mine gases and bringing fresh air into the mine are emphasized. Practice mine ventilation maps, a table-top mine model (which could be made by mining students), materials such as framing lumber, brattice cloth, and cement blocks for construction of masonry stoppings, etc., would be helpful in the teaching of these competencies.

A background of general knowledge concerning coal mining including its technical development, the major types of coal mines, methods of underground and surface coal extraction, preparation and transportation, and the impact of coal mining on the U.S. and State economies is considered moderately important for entry-level miners. Similar importance ratings were assigned knowledges of the uses of coal (present and future), the environmental effects of coal production and use, and land reclamation laws, rules and regulations. Instruction involving these kinds of information on coal mining would be reinforced by field trips to different types of mines, preparation plants, and sites reflecting well-planned reclamation procedures and practices.

Entry-level miners would benefit from a familiarity with mining machinery and equipment. It is very unlikely that mining programs at the secondary level would have access to their own mining machinery or equipment unless it was donated to them by a mining company. However, through photographs, printed materials and audio-visual aids, mining students can learn a considerable amount about mining machinery and equipment. This is one instance where a cooperative relationship with local mining companies, perhaps encouraged by their inclusion on a mining Curriculum Advisory Committee might make possible field trips to nearby mines for above-ground observation of equipment and machinery.

Knowledge of the basic terminology, equipment methods, and practices used in the transportation of coal is included among those competencies considered to be of moderate importance. Transportation methods might vary considerably from mine to mine according to the type of mine, its size and the company owning the mine. Mining students can become familiar with

types of coal haulage used by mines in the geographic areas in which they intend to seek employment. The **ability to maintain track** for the transportation of coal was also considered to be moderately important.

The competency involving knowledge of the **need for and methods of water control in mines** is regarded as being of moderate importance for entry-level miners. Students can learn both the sources of mine water and the methods and equipment used in its removal.

#### **Competencies of Little or No Importance for Coal Miner Training at the Secondary Level.**

Many competencies included in the survey instrument received mean importance ratings of less than 1.99 (Of Little or No Importance for entry-level miners). Of interest to secondary level coal mining curriculum planners is the fact that, **for the most part, the competencies receiving ratings of little or no importance to entry-level coal miners are those involving the more complex skills, extremely expensive equipment and machinery, and long periods of training and experience.** These included the operation and maintenance of major pieces of mining machinery, installation of electrical, mechanical or hydraulic systems or components, diagnosis and correction of malfunctions in equipment or machinery, etc. In some cases the training must come through apprenticeship or instruction by a highly skilled or certified master craftsman (such as in the case of an electrician). Other skills are mining-machinery specific and require that the student have access to those pieces of machinery or equipment involved in the competencies relating to their operation, maintenance or repair. These high-level skills are vitally important to the mining industry, but entry-level miners do not need these complex skills and, in fact, are excluded from those jobs involving such skills by the classification of jobs in the Bituminous Coal Wage Agreement of 1978.

**In contrast to those competencies rating of little or no importance for entry-level miners, the competencies**

**ranking highest in importance for secondary level coal mining curricula require instruction involving more easily taught basic skills, knowledges and understandings, the use of a minimum of coal mining-specific equipment, and relatively shorter periods of training.** These competencies lend themselves to large group instruction in a classroom, lab/shop setting and call for a relatively modest investment in instructional materials and equipment. Fortunately, those materials are available and have been identified with reference to the specific competencies they cover in Table II.

**Table II**

#### **Occupational Competencies Matched to Available Instructional Materials**

Table II presents the second product of the project — a listing of occupational competencies, each matched to numbers which represent instructional/training materials. These materials contain information useful for the teaching of the particular competency. The numbers refer to instructional/training materials as listed in Table IV (Inventory of Available Instructional/Training Materials by Source).

Instructional materials located during the course of the project were reviewed or previewed (films, etc.) by CONSERVA staff and judged as to their coverage of competencies potentially important to entry-level coal miners. Each material was numbered and a listing was made showing which competencies were included in the scope of the instructional material.

If there is a **considerable amount of information given** relating to the competency, **only the number of the resource is listed.** An asterisk (\*) following the material number indicates that the instructional material provides **limited information** relating to the competency.

**Table II. Occupational Competencies Matched to  
Available Instructional Materials**

| Section I Knowledges and Understandings<br>Important for Entry-level Coal Mining                                                                                                                                            | Resource or Instructional Material<br>Containing Relevant Information                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Occupational and job opportunities in the coal mining industry                                                                                                                                                           | 1, 2, 21, 64, 66, 127*, 158*, 271*, 272                                                                                                                                                                                                                                                                                                        |
| 2. Basic coal mining terminology                                                                                                                                                                                            | 1, 2, 3*, 21, 22, 25*, 26*, 27*, 28*, 29*, 30*, 33*, 38*, 52*, 54, 58, 60, 66, 87, 93, 118*, 127*, 271, 272*, 283*, 284*, 285*, 287*                                                                                                                                                                                                           |
| 3. The history and growth of coal mining as an industry                                                                                                                                                                     | 1, 21, 60, 64*, 66, 87, 117*, 271*                                                                                                                                                                                                                                                                                                             |
| 4. The technical development of the coal industry, including its impact on the U.S. and the State economy                                                                                                                   | 21, 60, 64*, 66, 103*, 271*                                                                                                                                                                                                                                                                                                                    |
| 5. The geology of coal and ores (or carbon fuels)                                                                                                                                                                           | 1, 3*, 21, 54, 60, 64*, 66, 87*, 88*, 271, 272                                                                                                                                                                                                                                                                                                 |
| 6. The uses of coal — present and future — and the forms in which coal is used                                                                                                                                              | 1, 21, 60, 64*, 66, 127*, 271, 272                                                                                                                                                                                                                                                                                                             |
| 7. Environmental effects of coal production and use                                                                                                                                                                         | 1, 21, 171*, 271                                                                                                                                                                                                                                                                                                                               |
| 8. Land reclamation laws, rules and regulations                                                                                                                                                                             | —                                                                                                                                                                                                                                                                                                                                              |
| 9. The management and labor structure of the coal mining industry (or a mining company or a typical mine)                                                                                                                   | 21, 87                                                                                                                                                                                                                                                                                                                                         |
| 10. UMWA and the current National Bituminous Coal Wage Agreement                                                                                                                                                            | 21, 64*, 278*                                                                                                                                                                                                                                                                                                                                  |
| 11. Governmental agencies (National, State, local) that are concerned with the mining industry                                                                                                                              | 21                                                                                                                                                                                                                                                                                                                                             |
| 12. Mining laws, regulations, health and safety codes (Federal, State)                                                                                                                                                      | 3*, 5, 6, 21, 22*, 23*, 24*, 31*, 32*, 37*, 38*, 40*, 46*, 47*, 49, 50, 51*, 58, 59, 66, 87, 90, 92, 102*, 137, 273*                                                                                                                                                                                                                           |
| 13. Local company policies, procedures, rules and regulations                                                                                                                                                               | —                                                                                                                                                                                                                                                                                                                                              |
| 14. Types of mines (shaft, drift and slope) and their characteristics                                                                                                                                                       | 1, 2, 6*, 21, 60, 87, 127*, 170*                                                                                                                                                                                                                                                                                                               |
| 15. The major methods of underground and surface coal extraction, preparation and transportation                                                                                                                            | 1, 3*, 21, 60, 66, 87, 116*, 118*, 127, 128, 133, 274*, 283, 284, 193*                                                                                                                                                                                                                                                                         |
| 16. Applied mathematics including topics such as basic functions (addition, subtraction, multiplication, division) fractions, decimals, percentage, measurement and units of measure, ratio and proportion, area and volume | 1*, 8*, 9, 10*, 14, 16*, 19*, 20*, 22*, 26*, 27*, 28*, 29*, 30*, 31*, 32*, 33*, 34*, 36*, 37*, 38*, 39*, 40*, 46*, 47*, 48*, 49*, 50*, 52*, 67*, 68*, 69*, 70*, 71*, 72*, 73*, 74*, 77, 79*, 89*, 92, 93*, 96, 102*, 107*, 123*, 124*                                                                                                          |
| 17. Physical properties of mine gases such as elasticity, weight, density, specific gravity, color, odor, taste, etc.                                                                                                       | 1, 3*, 8, 21, 25, 26, 27*, 28*, 29*, 30*, 32*, 33*, 34*, 36*, 37*, 39*, 40, 52*, 53, 61, 66, 87*, 88*, 92, 96, 102*, 120*, 282*, 286*                                                                                                                                                                                                          |
| 18. Effects of temperature and pressure on gases                                                                                                                                                                            | 1, 3*, 8, 21, 61, 92, 96, 102*                                                                                                                                                                                                                                                                                                                 |
| 19. Diffusion of gases (Graham's Law); occlusion and absorption                                                                                                                                                             | 1, 3*, 21, 53, 92, 96                                                                                                                                                                                                                                                                                                                          |
| 20. Moisture content of air and its implications in coal mining; solubility of gases in water                                                                                                                               | 3*, 21, 22*, 25*, 38*, 53, 61, 66, 92, 96                                                                                                                                                                                                                                                                                                      |
| 21. Chemical composition of air in the mines                                                                                                                                                                                | 1, 3*, 8, 21, 32*, 37*, 53, 61, 66, 88*, 92, 96                                                                                                                                                                                                                                                                                                |
| 22. Combustibility or ability of gases to support combustion                                                                                                                                                                | 1*, 3*, 8, 21, 25, 27*, 28*, 29, 30*, 32*, 35*, 36*, 37*, 40, 53, 61, 66, 92, 96, 102*, 273*                                                                                                                                                                                                                                                   |
| 23. Hazards and physiological effects associated with specific gases, combinations of gases, and/or deficiency of gas(es); mine damps                                                                                       | 1, 3*, 8, 21, 23, 24, 25, 26, 32*, 34*, 36*, 37, 39, 40, 53, 61, 63, 66, 87, 88, 92, 96, 102*, 120*, 121*, 129, 282*                                                                                                                                                                                                                           |
| 24. Methods of detecting mine gases and gas detection instruments.                                                                                                                                                          | 1*, 3*, 8, 21, 25, 26, 27*, 28*, 29*, 30*, 32*, 33*, 34*, 35*, 37, 39, 52*, 53, 61, 66, 87, 88*, 92, 96, 109*, 113*, 122*, 123*, 124*, 129, 147, 198, 199, 200, 201, 202, 203, 205, 206, 207, 208, 209, 212, 221, 222, 223, 224, 225, 226, 228, 229, 230, 231, 232, 235, 247, 253, 254, 255, 256, 259, 260, 261, 262, 267, 268, 269, 270, 286* |
| 25. Sampling and analysis of mine air                                                                                                                                                                                       | 1*, 8, 21, 22*, 25, 26, 27*, 28*, 29*, 30*, 32*, 33*, 34*, 35*, 37, 39, 52*, 53, 61, 88*, 92, 96, 123*, 198, 199, 200, 201, 202, 203, 206, 207, 208, 209, 212                                                                                                                                                                                  |
| 26. Atmospheric pressure and its effects on mine ventilation requirements                                                                                                                                                   | 3*, 8, 21, 22*, 92, 96                                                                                                                                                                                                                                                                                                                         |
| 27. Mine ventilation systems and their components                                                                                                                                                                           | 1, 3*, 4*, 6, 7, 8, 21, 22, 58, 66, 87, 92, 93, 133, 173, 194*, 195, 218, 285, 287                                                                                                                                                                                                                                                             |

Table II — continued

| Section I — Knowledges and Understandings<br>Important for Entry-level Coal Mining                                                                                                                                                                                                       | Resource or Instructional Material<br>Containing Relevant Information                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28. Mine ventilation maps — symbols and definitions                                                                                                                                                                                                                                      | 1, 3*, 4, 6, 7, 21, 22*, 66*, 87, 92, 93, 97, 285, 287*                                                                                                                                                          |
| 29. Velocity of air and mine resistance to an air current                                                                                                                                                                                                                                | 1, 3*, 4*, 6, 7, 8, 21, 22, 66*, 92, 93, 126, 285                                                                                                                                                                |
| 30. Construction and component parts of ventilation systems                                                                                                                                                                                                                              | 1, 4*, 6, 7, 8*, 16*, 17*, 21, 22, 66*, 87, 93, 285, 287*                                                                                                                                                        |
| 31. Physical principles of roof control systems for various types of roof conditions                                                                                                                                                                                                     | 1, 3*, 21, 38, 54, 66, 143                                                                                                                                                                                       |
| 32. Basic procedures for roof and rib control                                                                                                                                                                                                                                            | 1, 3*, 16*, 21, 38, 47*, 54, 66, 87, 143, 211, 234, 283                                                                                                                                                          |
| 33. Visual and auditory cues denoting hazardous roof and rib conditions                                                                                                                                                                                                                  | 1, 3*, 21, 47*, 66, 87                                                                                                                                                                                           |
| 34. Appropriate methods of testing roofs and roof structures                                                                                                                                                                                                                             | 1, 3*, 21, 38, 48*, 49*, 66, 87                                                                                                                                                                                  |
| 35. Principal causes of mine fires and explosions                                                                                                                                                                                                                                        | 1, 3*, 8, 21, 49*, 50*, 53, 58, 66, 87, 88, 90, 96*, 137, 141, 144*, 146, 273*                                                                                                                                   |
| 36. Chemical reactions resulting from mine fires and explosions                                                                                                                                                                                                                          | 8*, 21, 23, 24, 25, 26, 37*, 50*, 53, 58, 66, 88, 90, 96                                                                                                                                                         |
| 37. Methods used in the prevention of mine fires and explosions                                                                                                                                                                                                                          | 1, 3*, 8, 21, 25, 37, 50*, 53, 58, 66, 87, 88, 90, 112*, 137, 146, 273*                                                                                                                                          |
| 38. Safest and most effective methods of fighting mine fires                                                                                                                                                                                                                             | 1, 3*, 6, 8, 21, 50*, 66, 87, 88, 90, 112*, 141, 213, 245*                                                                                                                                                       |
| 39. The uses of explosives and blasting procedures used in coal mining                                                                                                                                                                                                                   | 1, 3*, 8, 21, 90, 184                                                                                                                                                                                            |
| 40. Explosion hazards and safety precautions during blasting                                                                                                                                                                                                                             | 1, 3*, 8, 21, 26, 31*, 58, 59, 90, 96*, 161*, 184                                                                                                                                                                |
| 41. Fundamentals of First-Aid for various types of medical emergencies — accidents, fires, heart attacks, electrical shock etc.                                                                                                                                                          | 1, 8, 21, 55, 62, 66, 87, 94, 140, 148, 160, 174*, 217, 250                                                                                                                                                      |
| 42. General health and safety procedures and practices in the mines                                                                                                                                                                                                                      | 1, 3*, 8, 21, 31*, 38*, 46*, 48*, 49*, 50*, 51*, 58, 66, 87, 109*, 120, 129, 136, 145, 154*, 155*, 159*, 169*, 170*, 172*, 174*, 175*, 176*, 177*, 178*, 179*, 180*, 181*, 187*, 188*, 196, 197, 279*, 280*, 289 |
| 43. Uses and requirements of personal mine safety equipment                                                                                                                                                                                                                              | 8, 21, 23, 24, 25, 26, 61, 66, 87, 88, 120, 121*, 129, 196, 197, 219, 220, 251, 252, 257, 258, 263, 264, 265, 266, 282*                                                                                          |
| 44. Mine rescue training                                                                                                                                                                                                                                                                 | 1*, 8*, 37, 42*, 43*, 44*, 66, 88, 141, 162, 210, 233, 237*, 238*, 239*                                                                                                                                          |
| 45. Safe and proper use and care of instruments, hand tools, power tools and equipment                                                                                                                                                                                                   | 8*, 11, 16*, 21, 23, 24, 25, 26, 27*, 28*, 51*, 52*, 66, 79*, 87, 104*, 109*, 113*, 122*, 123*, 126, 129, 136, 137, 154*, 274*, 286*, 289*                                                                       |
| 46. Basic terminology applying to haulage and haulage-way equipment                                                                                                                                                                                                                      | 1, 3*, 8*, 21, 48, 51*, 66, 87, 133, 283*, 284*, 289                                                                                                                                                             |
| 47. Equipment, methods and practices used in the transportation of coal                                                                                                                                                                                                                  | 1, 3*, 8, 21, 48, 51*, 60, 66, 87, 127, 133, 183, 283*, 284*, 289                                                                                                                                                |
| 48. Basic electrical terms, symbols and definitions                                                                                                                                                                                                                                      | 1, 3*, 8, 15, 19*, 21, 46*, 48, 52*, 57, 66*, 67, 68, 69, 70, 71, 72, 73, 74, 75, 78, 87, 89, 91, 98, 101, 105, 132, 273*, 288                                                                                   |
| 49. Basic electrical theory including voltage, amperage and wattage and their measurement, resistance and line drops, series and parallel circuits, alternating and direct current electricity, magnetism, etc.                                                                          | 1, 3*, 8, 15, 19*, 20*, 46*, 49*, 57, 67, 68, 69, 70, 71, 72, 73, 74*, 75*, 78*, 89, 91, 98, 101, 105, 111, 114, 115, 132, 274*, 288                                                                             |
| 50. Functions and applications of electrical circuits, generators, types of electrical controls, transformers, and solid state systems in coal mining                                                                                                                                    | 1, 3*, 8, 21, 46*, 48*, 49*, 57, 89, 91, 110, 111*, 114*, 119*, 273*, 288*                                                                                                                                       |
| 51. Fundamental principles of construction and operation of electric motors as components of mining machinery and equipment                                                                                                                                                              | 1*, 74, 89, 91*, 98*, 114*, 273*                                                                                                                                                                                 |
| 52. Schematic drawings of electrical circuits, electrical systems, components, etc.                                                                                                                                                                                                      | 1, 15, 19*, 20*, 68, 69, 70, 71*, 72*, 73*, 74*, 75*, 76, 78, 89, 105*, 111*, 114*, 119*, 288                                                                                                                    |
| 53. Mine electrical power transmission — procedures involved in installation and maintenance of electrical power transmission systems as used in underground coal mines; application of mining laws to power transmission, safety ground systems, circuits and cable monitoring circuits | 21, 89, 91*, 275*, 288*                                                                                                                                                                                          |

Table II — continued

| Section I Knowledges and Understandings<br>Important for Entry-level Coal Mining                                                                                                                                                                                             | Resource or Instructional Material<br>Containing Relevant Information |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 54. Basic terminology, systems and definitions pertaining to hydraulics — hydraulic systems, fluid properties                                                                                                                                                                | 8, 21, 65, 77, 85, 86*, 99, 106, 107*, 108*, 130*, 131*, 134, 275*    |
| 55. Basic principles of hydraulics (e.g. Pascal's Law); characteristics of fluids in motion; measurable pressures affecting liquid flow, etc.                                                                                                                                | 21, 65, 77, 85, 99, 106, 107*, 134                                    |
| 56. Hydraulic application of mechanics in fluid power: 1) work, pressure, acceleration, energy; 2) inertia, power, efficiency                                                                                                                                                | 21, 65, 77, 85, 134                                                   |
| 57. Hydraulic power transmission — pipe tube and hose conductors; physical properties; friction                                                                                                                                                                              | 21, 65, 77, 85, 86, 99*, 100, 134, 275*                               |
| 58. Function and operation of hydraulic accessory equipment such as reservoirs, accumulators, filters, boosters, instruments, heat exchangers, etc.                                                                                                                          | 65, 77, 85, 99, 100, 106, 107*, 134, 275*                             |
| 59. Hydraulic fluids — characteristics affecting performance of hydraulic systems; maintenance, storage and handling of hydraulic fluids                                                                                                                                     | 21, 65, 85, 86, 99, 108, 134, 275*                                    |
| 60. Applications/uses of hydraulic power in coal mining including cylinders, valves, motors, pumps, controls and other components of a fluid power system                                                                                                                    | 1, 21*, 46*, 48*, 65, 83, 84, 85*, 99*, 130, 131*, 275*               |
| 61. Need for and methods of water control in coal mines                                                                                                                                                                                                                      | 1, 3*, 8, 21                                                          |
| 62. Fundamentals of machines used in underground mining and transportation of coal — their construction, procedures for operation and maintenance                                                                                                                            | 1*, 21*, 46*, 48*, 51*                                                |
| 63. Mechanical power transmission — functions of gears, coupling, drive shafts, belts, etc.                                                                                                                                                                                  | 79*, 81, 135                                                          |
| 64. Functions of the major pieces of mining machinery and equipment such as: universal cutting machine, face drill, loading machine, shuttle car, roof bolter, continuous miner, conveyor, locomotive, trolley, dump and scoop                                               | 1, 46*, 48*, 51*, 87, 103, 289                                        |
| 65. Graphics such as orthographics, multiviews and working drawings of mining machines and equipment (e.g. blueprints, three-view projections, skeleton views, exploded views, etc.)                                                                                         | 10*, 77, 275*                                                         |
| 66. Industrial electricity — procedures for installation, removal and/or replacement operation of electrical switches, disconnect devices, cables, lines, lights, transformers, etc.; electric motors, power or control circuit wiring, communication systems, etc.          | 89, 91*                                                               |
| 67. Lubrication — types of lubricants, lubricating equipment, lubricating charts, lubricating checks and inspections; procedures for lubrication of gear boxes, bearings, grease cups, etc.; oiling of conveyor chains; freeing of frozen rollers; packing of bearings, etc. | 80*, 82*, 125*                                                        |
| 68. Welding — fundamental principles of welding (heliarc and oxy-acetylene, MIG and TIG, etc.) including equipment and capabilities of each type; uses in construction, maintenance or repair of mining machinery, equipment, structures or systems                          | 12, 13, 18, 276*, 277*                                                |
| 69. Mechanics — procedures for installation, operation, maintenance, repair and replacement of parts of mining machinery including bearings, oil seals, gears, coupling and drive shafts, sprockets and chains, conveyors, etc.                                              | 81, 82*                                                               |
| 70. Hydraulics — procedures for installation, operation, adjustment, repair and replacement of the hydraulic systems or components of machines used in the mining or transporting of coal                                                                                    | 86*, 100, 275*                                                        |
| 71. Pneumatics — procedures for installation, operation, maintenance, repair and replacement of pneumatic systems or pneumatic components of machinery used in the mining or transporting of coal                                                                            |                                                                       |

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Table II — continued

| Section II Abilities/Skills Related to Coal Mining Occupations                                                                                                                                                                                                               | Resource or Instructional Material Containing Relevant Information                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Able to read and demonstrate comprehension of technical material, maps, drawings, etc. related to coal mining activities                                                                                                                                                  | 10*, 22*, 87*, 89*, 93, 111*, 114*, 119*                                                                                                                                                                                                                                               |
| 2. Able to interpret and accurately prepare written reports                                                                                                                                                                                                                  | See unnumbered reference material entitled <i>Methods and Materials for Teaching Occupational Survival Skills</i>                                                                                                                                                                      |
| 3. Able to follow oral and written directions effectively                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                        |
| 4. Able to work cooperatively with others                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                        |
| 5. Able to demonstrate good attitudes and work habits such as proper care of tools and equipment, regular and punctual attendance, job motivation and initiative, etc.                                                                                                       | 149, 151, 155*, 156*, 157*                                                                                                                                                                                                                                                             |
| 6. Able to solve mathematics problems in coal mining activities, such as determining percentages of mine gases; calculating volume of gases, liquids, and solids; measurement of temperature, pressure, area, weight and distance, velocity of air; power calculations, etc. | 9*, 14*, 21, 22*, 26*, 27*, 28*, 29*, 30*, 31*, 33*, 34*, 36*, 37*, 38*, 39*, 40*, 46*, 47*, 48*, 49*, 50*, 52*, 88, 89*, 92, 93*, 96, 123*                                                                                                                                            |
| 7. Able to detect and identify mine gases either by their physical properties (color, odor, taste, etc.) or by using the flame safety lamp, the permissible methane spotter, bulb-type gas detectors or other methods                                                        | 21, 25, 26, 27*, 28*, 29*, 30*, 33*, 34*, 35*, 36*, 37, 39*, 40*, 46*, 52*, 53, 61, 88, 92, 96, 109*, 122*, 123*, 124*, 126*, 129*, 147, 173, 286*                                                                                                                                     |
| 8. Able to recognize and take proper safety measures to escape or correct hazardous mine conditions (including mine damp) caused by gases                                                                                                                                    | 21, 23, 24, 25*, 26*, 37, 40, 46*, 53, 61, 87, 88*, 92*, 96, 109*, 120*, 126*, 129*, 279*, 280*                                                                                                                                                                                        |
| 9. Able to design a ventilation system in a model mine, demonstrating ventilation structures and the use of ventilation maps                                                                                                                                                 | 4*, 7, 21, 22, 58, 92*, 93, 97, 285*                                                                                                                                                                                                                                                   |
| 10. Able to construct ventilation structures such as brattice and tubing, masonry and metal stoppings and overcasts                                                                                                                                                          | 21, 17*, 22, 40, 46*, 92*, 93*                                                                                                                                                                                                                                                         |
| 11. Able to demonstrate correct basic roof and rib control construction and installation practices and procedures                                                                                                                                                            | 21, 38, 47, 54                                                                                                                                                                                                                                                                         |
| 12. Able to test roof using proper procedures, visual and auditory cues, testing rods or other equipment                                                                                                                                                                     | 21, 38, 46, 47, 48, 49*, 54, 87                                                                                                                                                                                                                                                        |
| 13. Able to demonstrate procedures and techniques which serve to prevent the occurrence of mine fires or explosions                                                                                                                                                          | 21, 35*, 46*, 49*, 50*, 52*, 58, 88, 90*, 93*, 96*                                                                                                                                                                                                                                     |
| 14. Able to demonstrate proper fire fighting techniques for controlling mine fires                                                                                                                                                                                           | 21, 37, 50, 53, 88, 90                                                                                                                                                                                                                                                                 |
| 15. Able to demonstrate proper safety precautions to be taken during blasting in mines                                                                                                                                                                                       | 21, 31*, 59, 88, 96*                                                                                                                                                                                                                                                                   |
| 16. Able to administer correct First Aid treatment in various types of medical emergencies — accidents, fires, explosions, heart attacks, etc.                                                                                                                               | 21, 55, 62, 94, 140, 148, 160, 174*, 175*, 176*, 177*, 178*, 179*, 180*, 181*, 217, 250                                                                                                                                                                                                |
| 17. Able to recognize and avoid hazards caused by unsafe mine conditions, mine machinery, electrical or other equipment, defective tools, etc.                                                                                                                               | 21, 23, 24, 25*, 31*, 38*, 39*, 46*, 47, 48, 49*, 50*, 51*, 53, 54, 57, 58, 59*, 61, 63, 87, 88, 90*, 91*, 92*, 109*, 120*, 129, 136, 137, 138, 139, 150, 161*, 165*, 166*, 167*, 168, 172*, 182*, 183*, 185*, 190*, 191, 192*, 193*, 194*, 204*, 227, 246*, 248, 249, 280, 288*, 289* |
| 18. Able to use and care for personal equipment correctly and safely                                                                                                                                                                                                         | 21, 23, 24, 25*, 26*, 37, 88*, 120*, 129*, 149*, 195, 196, 219, 220, 251, 252, 257, 258, 263, 264, 265, 266, 280*                                                                                                                                                                      |
| 19. Able to demonstrate proper procedures and practices for mine rescue in various emergency situations such as fires, explosions, roof falls, etc.                                                                                                                          | 37, 42*, 43*, 44*, 53, 88*, 90*, 142, 186                                                                                                                                                                                                                                              |
| 20. Able to demonstrate correct procedures for escape or self-rescue in case of mine fires or explosions                                                                                                                                                                     | 21, 23, 24, 37, 40, 53, 88, 90, 120*, 142, 186, 213, 236, 279*, 280                                                                                                                                                                                                                    |
| 21. Able to use instruments, hand tools, power tools, and equipment properly and safely                                                                                                                                                                                      | 11*, 16*, 21*, 23*, 24*, 25*, 26*, 27*, 28*, 29*, 30*, 31*, 33*, 34*, 35*, 36*, 37, 38*, 39*, 42*, 43*, 44*, 46*, 47*, 48*, 49*, 50*, 51*, 52*, 57*, 87, 104*, 109*, 122*, 123*, 126*, 129*, 149, 274*, 280, 286*, 289*                                                                |

Table II — continued

| Section II Abilities/Skills Related to Coal Mining Occupations                                                                                                                                                                  | Resource or Instructional Material Containing Relevant Information       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 22. Able to prepare a roadbed for transportation equipment used in the mining of coal                                                                                                                                           | 21                                                                       |
| 23. Able to lay track properly                                                                                                                                                                                                  | 21                                                                       |
| 24. Able to maintain track and trolleys in a safe manner                                                                                                                                                                        | 21                                                                       |
| 25. Able to apply knowledge of basic electrical theory, electrical circuits, motors, generators, controls, transformers, solid state systems, etc., to mining activities                                                        | 19*, 20*, 43*, 47*, 49*, 57*, 89*, 91, 104*, 111, 114*, 115*, 119*, 288* |
| 26. Able to diagnose and correct malfunctions in electrical components of mining machinery and equipment                                                                                                                        | 19*, 20*, 49*, 76*, 89*, 91, 111, 119*                                   |
| 27. Able to use schematic drawings in installation, maintenance or repair of mine electrical systems, motors or components                                                                                                      | 19*, 20*, 76*, 89*, 111                                                  |
| 28. Able to install, maintain, or repair electrical power transmission systems as used in underground coal mines                                                                                                                | 49*, 89*, 91*                                                            |
| 29. Able to interpret and use drawings, orthographics or multiviews as used in the construction, operation, repair or maintenance of coal mining structures, machinery or equipment                                             | 10*, 19*, 20*, 77*, 111, 114*, 119*                                      |
| 30. Able to install, maintain or repair hydraulic power transmission systems as used in underground coal mines                                                                                                                  | —                                                                        |
| 31. Able to diagnose and correct malfunctions of mine hydraulic systems or components of coal mining machinery and equipment (i.e. cylinders, valves, pumps, controls)                                                          | 275*                                                                     |
| 32. Able to design a plan for mine water removal                                                                                                                                                                                | 21*                                                                      |
| 33. Able to install and maintain pumps for mine water removal                                                                                                                                                                   | 21*                                                                      |
| 34. Able to install piping for mine water removal                                                                                                                                                                               | 21*                                                                      |
| 35. Able to operate the major pieces of mining machinery and equipment such as universal cutting machine, face drill, loading machine, shuttle car, roof bolter continuous miner, conveyor, locomotive, trolley, dump and scoop | 46*, 47*, 48*, 51*, 241, 242, 243                                        |
| 36. Able to make minor adjustments or repairs to mining machinery and equipment                                                                                                                                                 | 46*, 47*, 48*, 51*                                                       |
| 37. Able to install, maintain or repair mechanical power transmission systems as used in underground coal mining                                                                                                                | —                                                                        |
| 38. Able to perform arc or oxy-acetylene welding, or MIG or TIG where required for mine machinery and equipment repair, construction or maintenance of mine structures or systems                                               | 12, 13, 18                                                               |
| 39. Able to install, maintain, remove and/or replace electrical switches, motors, cables, lines, lights, transformers, etc.                                                                                                     | 89*, 91                                                                  |
| 40. Able to perform various types of lubrication jobs (gear box, bearings, oiling of conveyor chains, etc.) using proper lubricants and equipment                                                                               | —                                                                        |
| 41. Able to diagnose and correct mechanical malfunctions in mining machinery and equipment                                                                                                                                      | —                                                                        |
| 42. Able to install, remove and/or replace mining machinery or equipment parts such as bearings, gears, coupling and drive shafts, belts, etc.                                                                                  | —                                                                        |
| 43. Able to diagnose and correct malfunctions of pneumatic systems or components used in the mining or transporting of coal                                                                                                     | —                                                                        |
| 44. Able to install and maintain pneumatic systems or pneumatic components of mining equipment and machinery                                                                                                                    | —                                                                        |

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**Table III**

**Inventory of Available Instructional/Training Materials Matched to the Coal Mining Competencies Which They Cover**

Table III presents the third product of the project — a listing of instructional materials matched to the mining competencies on which information is provided. The reader will note that Table III is a reversal of the information presented in Table II, and it has a different purpose.

Table II allows curriculum planners to see what materials are available to teach coal mining competencies listed. Table III lists each material and indicates all competencies included in the instructional material. This allows planners to see the scope of competency coverage of each instructional material.

The information provided in Table III can aid curriculum planners in the selection of instructional materials. Materials can be identified which have a broad scope of competency coverage. In contrast, those materials that provide in-depth coverage of one or a few related competencies can also be readily identified by using Table III.

**Table III. Inventory of Available Instructional/Training Materials Matched to the Coal Mining Competencies Which They Cover**

| Instructional/Training Material                                        | Competencies<br>(As listed in Table II)                                                                                                                                         |                    |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|                                                                        | Knowledges/Understandings                                                                                                                                                       | Abilities/Skills   |
| 1. <i>Elements of Practical Coal Mining</i>                            | 1, 2, 3, 5, 6, 7, 14, 15, 16*, 17, 18, 19, 21, 22*, 23, 24*, 25*, 27, 28, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 44*, 46, 47, 48, 49, 50, 51*, 52, 60, 61, 62*, 64 |                    |
| 2. <i>Mining Industry Occupations</i>                                  | 1, 2*, 14*                                                                                                                                                                      |                    |
| 3. <i>Basic Coal Mining Workbook</i>                                   | 2*, 5*, 12*, 15*, 17*, 18*, 29*, 20*, 21*, 22*, 23*, 24*, 26*, 27*, 28*, 29*, 31*, 32*, 33*, 34*, 35*, 37*, 38*, 39*, 40*, 42*, 46*, 47*, 48*, 49*, 50*, 61*                    |                    |
| 4. <i>Basic Workbook Practice Maps</i>                                 | 27*, 28, 29*, 30*                                                                                                                                                               | 9*                 |
| 5. <i>Federal Underground Coal Mine Safety Laws</i>                    | 12                                                                                                                                                                              |                    |
| 6. <i>Map Workbook</i>                                                 | 12, 14*, 27, 28, 29, 30, 38                                                                                                                                                     |                    |
| 7. <i>Practice Map Advanced Series</i>                                 | 27, 28, 29, 30                                                                                                                                                                  | 9                  |
| 8. <i>The Underground Supervisor</i>                                   | 16*, 17, 18, 21, 22, 23, 24, 25, 26, 27, 29, 30*, 35, 36*, 37, 38, 39, 40, 41, 42, 43, 44*, 45*, 46*, 47*, 48, 49, 50, 54, 61                                                   |                    |
| 9. <i>Plant Mathematics — Whole Numbers</i>                            | 16                                                                                                                                                                              | 6*                 |
| 10. <i>Reading Engineering Drawings</i>                                | 16*, 65*                                                                                                                                                                        | 1*, 29*            |
| 11. <i>ABC's of Hand Tools, Their Correct Usage and Care</i>           | 45*                                                                                                                                                                             | 21*                |
| 12. <i>Basic Fundamentals of Arc Welding</i>                           | 68*                                                                                                                                                                             | 38*                |
| 13. <i>Basic Fundamentals of Oxyacetylene Welding</i>                  | 68*                                                                                                                                                                             | 38*                |
| 14. <i>Basic Mathematics</i>                                           | 16                                                                                                                                                                              | 6*                 |
| 15. <i>Electricity</i>                                                 | 48, 49, 52                                                                                                                                                                      |                    |
| 16. <i>Modern Carpentry</i>                                            | 16*, 30*, 32*, 45*                                                                                                                                                              | 21*                |
| 17. <i>Modern Masonry</i>                                              | 30*                                                                                                                                                                             | 10*                |
| 18. <i>Modern Welding</i>                                              | 68                                                                                                                                                                              | 38                 |
| 19. <i>A Training Program for Alternating Current Mining Machinery</i> | 16*, 48*, 49*, 52*                                                                                                                                                              | 25*, 26*, 27*, 29* |
| 20. <i>A Training Program for Direct Current Mining Machinery</i>      | 16*, 48, 49*, 52*                                                                                                                                                               | 25*, 26*, 27*, 29* |

\*Provides limited information on the competency

Table III — continued

| Instructional/Training Material                                                       | Competencies<br>Knowledges/Understandings                                                                                                                                                                            | Abilities/Skills                                                                   |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 21. <i>Underground Mining — Volume I</i>                                              | 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 45, 46, 47, 48, 50, 53, 54, 55, 56, 57, 59, 60*, 61, 62*, 64 | 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21*, 22, 23, 24, 32*, 33*, 34* |
| 22. <i>Coal Mine Ventilation</i>                                                      | 2, 12*, 16*, 20*, 25*, 26*, 27, 28*, 29, 30                                                                                                                                                                          | 1*, 6*, 9, 10                                                                      |
| 23. <i>MSA W-65 Self-Rescuer</i>                                                      | 12*, 23, 36, 43, 45                                                                                                                                                                                                  | 8, 17, 18, 20, 21*                                                                 |
| 24. <i>Permissible Drager 810 Respirator for Self Rescue</i>                          | 12*, 23, 36, 43, 45                                                                                                                                                                                                  | 8, 17, 18, 20, 21*                                                                 |
| 25. <i>The MSA Hydrogen Sulfide Detector</i>                                          | 2*, 17, 20*, 22, 23, 24, 25, 36, 37, 43, 45                                                                                                                                                                          | 7, 8*, 17*, 18*, 21*                                                               |
| 26. <i>MSA Nitrogen Dioxide Detector</i>                                              | 2*, 16*, 17, 23, 24, 25, 36*, 40*, 43*, 45*                                                                                                                                                                          | 6*, 7, 8*, 18*, 21*                                                                |
| 27. <i>G-70 Permissible Methanometer</i>                                              | 2*, 16*, 17*, 22*, 24*, 25*, 45*                                                                                                                                                                                     | 6*, 7*, 21*                                                                        |
| 28. <i>Permissible Methanometer M-402</i>                                             | 2*, 16*, 17*, 22*, 24*, 25*, 45*                                                                                                                                                                                     | 6*, 7*, 21*                                                                        |
| 29. <i>Hand-Held Permissible Methane Indicating Detector</i>                          | 2*, 16*, 17*, 22*, 24*, 25*, 45*                                                                                                                                                                                     | 6*, 7*, 21*                                                                        |
| 30. <i>MSA Permissible Methane Spotter</i>                                            | 2*, 16*, 17*, 22*, 24*, 25*, 45*                                                                                                                                                                                     | 6*, 7*, 21*                                                                        |
| 31. <i>Fundamentals of Noise Measurement</i>                                          | 12*, 16*, 40*, 42*                                                                                                                                                                                                   | 6*, 15*, 17*, 21*                                                                  |
| 32. <i>Introduction to Courses in Oxygen Deficiency and Methane Detecting Devices</i> | 12*, 16*, 17*, 21, 22*, 23*, 24, 25                                                                                                                                                                                  | —                                                                                  |
| 33. <i>Riken Gas Indicator Types 17, 18, and 21</i>                                   | 2*, 16*, 17*, 24*, 25*, 45*                                                                                                                                                                                          | 6*, 7*, 21*                                                                        |
| 34. <i>Bacharach Monoxor Carbon Monoxide Indicator</i>                                | 16*, 17*, 23*, 24*, 25*, 45*                                                                                                                                                                                         | 6*, 7*, 21*                                                                        |
| 35. <i>MSA Explosimeter — Model 2A</i>                                                | 22*, 24*, 25*, 45*                                                                                                                                                                                                   | 7*, 13*, 21*                                                                       |
| 36. <i>Koehler and Wolf Permissible Flame Safety Lamps</i>                            | 16*, 17*, 22*, 23*, 24*, 45*                                                                                                                                                                                         | 6*, 7, 21*                                                                         |
| 37. <i>Principles of Mine Rescue</i>                                                  | 12*, 16*, 17*, 21*, 22*, 23, 24, 25, 36*, 38, 44                                                                                                                                                                     | 6*, 7, 8, 14, 18, 19, 20, 21                                                       |
| 38. <i>Roof and Rib Control</i>                                                       | 2*, 12*, 16*, 20*, 31, 32, 33, 34, 42*, 45*                                                                                                                                                                          | 6*, 11, 12, 17*, 21*                                                               |
| 39. <i>MSA Carbon Monoxide Tester</i>                                                 | 16*, 17*, 23*, 24, 25, 45*                                                                                                                                                                                           | 6*, 7*, 17*, 21*                                                                   |
| 40. <i>Mine Emergency Training</i>                                                    | 12*, 16*, 17, 22, 23                                                                                                                                                                                                 | 6*, 7*, 8, 17, 20                                                                  |
| 41. <i>Audio Visual Guide</i>                                                         | This guide is intended for instructional personnel. Competencies for entry-level coal mining do not apply.                                                                                                           | —                                                                                  |
| 42. <i>Mine Rescue Training Using the Drager BG 174, BG 174A Breathing Apparatus</i>  | 44*, 45*                                                                                                                                                                                                             | 19*, 21*                                                                           |
| 43. <i>Mine Rescue Training Using the Auxiliary Rescue Apparatus MSA CHEMOX</i>       | 44*, 45*                                                                                                                                                                                                             | 19*, 21*                                                                           |
| 44. <i>Mine Rescue Training Using the MSA McCaa Mine Rescue Apparatus</i>             | 44*, 45*                                                                                                                                                                                                             | 19*, 21*                                                                           |
| 45. <i>Instructor Training Guide</i>                                                  | This material is intended for the training of instructional personnel. Competencies for entry-level coal mining do not apply.                                                                                        | —                                                                                  |
| 46. <i>Job Safety Guide — Continuous Miner</i>                                        | 12*, 16*, 42*, 45, 48*, 49*, 50*, 60*, 62*, 64*                                                                                                                                                                      | 6*, 7*, 8*, 10*, 12, 13*, 17*, 21*, 25*, 35*, 36*                                  |
| 47. <i>Job Safety Guide — Roof-Bolting Operation</i>                                  | 12*, 16*, 32*, 33*, 34, 42*, 45*, 48*, 50*, 60*, 62*, 64*                                                                                                                                                            | 6*, 11, 12, 17, 21*, 25*, 35*, 36*                                                 |
| 48. <i>Job Safety Guide — Shuttle Car Operation</i>                                   | 12*, 16*, 34, 42*, 45*, 46, 47, 48, 50*, 60*, 62*, 64*                                                                                                                                                               | 6*, 12, 17, 21*, 35*, 36*                                                          |

Table III — continued

| Instructional/Training Material                                                  | Competencies<br>Knowledges/Understandings                                                                                            | Abilities/Skills                      |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 49. <i>Job Safety Guide — Trailing Cable Splicing</i>                            | 12*, 16*, 34*, 45*, 42*, 45*, 49*, 50*                                                                                               | 6*, 12*, 13*, 17*, 21*, 25*, 26*, 28* |
| 50. <i>Portable Fire Extinguishers</i>                                           | 12*, 16*, 18*, 35*, 36*, 37*, 38, 42*, 45*                                                                                           | 6*, 13*, 14*, 17*, 21*                |
| 51. <i>Rubber-Tired Front End Loader and Fork Lift Truck Accident Prevention</i> | 12*, 42*, 45*, 46*, 47*, 62*, 64*                                                                                                    | 17*, 21*, 35*, 36*                    |
| 52. <i>CSE Permissible Digital Methanometer Model 100</i>                        | 2*, 16*, 17*, 24*, 25*, 45*, 48*                                                                                                     | 6*, 7*, 13*, 21*                      |
| 53. <i>Mine Gases NMHSA-CE-002</i>                                               | 17, 19, 20, 21, 22, 23, 24, 25, 35, 36, 37                                                                                           | 7, 8, 14, 17, 19, 20                  |
| 54. <i>Roof and Rib Control — NMHSA-CE-003</i>                                   | 2, 5, 31, 32                                                                                                                         | 11, 12, 17                            |
| 55. <i>First Aid — Volume I Workbook NMHSA-CE-006</i>                            | 41                                                                                                                                   | 16                                    |
| 56. <i>Mine Illumination — NMHSA-CE-008</i>                                      | —                                                                                                                                    | —                                     |
| 57. <i>Electrical Hazards — Volume I Workbook</i>                                | 48, 49, 50                                                                                                                           | 17, 21, 25*                           |
| 58. <i>Coal Dust — Volume I NMHSA-CE-009</i>                                     | 2, 12, 27, 35, 36, 37, 40, 42                                                                                                        | 9*, 13, 17                            |
| 59. <i>Noise Control NMHSA-CE-011</i>                                            | 12, 40                                                                                                                               | 15, 17*                               |
| 60. <i>Coal Mining Safety Manual No. 1</i>                                       | 2, 3, 4, 5, 6, 14, 15, 47                                                                                                            | —                                     |
| 61. <i>Mine Gases Safety Manual No. 2</i>                                        | 17, 18, 20, 21, 22, 23, 24, 25, 43                                                                                                   | 7, 8, 17                              |
| 62. <i>First Aid — Safety Manual No. 3</i>                                       | 41                                                                                                                                   | 16                                    |
| 63. <i>Accident Prevention — Safety Manual No. 4</i>                             | 23                                                                                                                                   | 17                                    |
| 64. <i>SRA Occupational Brief — Coal Miners</i>                                  | 1, 3*, 4*, 5*, 6*, 10*                                                                                                               | —                                     |
| 65. <i>Sperry Vickers Mobile Hydraulics Manual</i>                               | 54, 55, 56, 57, 58, 59, 60*                                                                                                          | —                                     |
| 66. <i>New Miner Orientation Manual — An Instruction Training Manual</i>         | 1, 2, 3, 4, 5, 6, 12, 15, 17, 20, 21, 22, 23, 24, 27, 28*, 29*, 30*, 31, 32, 33, 34, 35, 36, 37, 38, 41, 42, 43, 44, 45, 46, 47, 48* | —                                     |
| 67. <i>Introduction to Electricity &amp; Electronics Unit 1</i>                  | 16*, 48, 49                                                                                                                          | —                                     |
| 68. <i>Batteries and D-C Circuits — Unit 2</i>                                   | 16*, 48, 49, 52                                                                                                                      | —                                     |
| 69. <i>Transformers and A-C Circuits — Unit 3</i>                                | 16*, 48, 49, 52                                                                                                                      | —                                     |
| 70. <i>Electrical Measuring Instruments — Unit 3</i>                             | 16*, 48, 49, 52*                                                                                                                     | —                                     |
| 71. <i>Electrical Protective Devices — Unit 5</i>                                | 16*, 48, 49, 52*                                                                                                                     | —                                     |
| 72. <i>D-C Equipment and Controls — Unit 6</i>                                   | 16*, 48, 49, 52*                                                                                                                     | —                                     |
| 73. <i>Single-Phase Motors — Unit 7</i>                                          | 16*, 48, 49, 52*                                                                                                                     | —                                     |
| 74. <i>Three-Phase Systems — Unit 8</i>                                          | 16*, 48, 49*, 51*, 52*                                                                                                               | —                                     |
| 75. <i>A-C Control Equipment — Unit 9</i>                                        | 48, 50*, 52*                                                                                                                         | —                                     |
| 76. <i>Electrical Troubleshooting — Unit 10</i>                                  | 52                                                                                                                                   | 26*, 27*                              |
| 77. <i>Basic Blueprint Reading — Unit 1</i>                                      | 16, 54, 55, 56, 57*, 58*, 65*                                                                                                        | 29*                                   |
| 78. <i>Reading Schematics and Symbols — Unit 2</i>                               | 48, 49*, 52                                                                                                                          | —                                     |
| 79. <i>Elements of Mechanics — Unit 1</i>                                        | 16*, 45*, 63*                                                                                                                        | —                                     |
| 80. <i>Lubrication — Unit 2</i>                                                  | 67*                                                                                                                                  | —                                     |
| 81. <i>Drive Components — Unit 3</i>                                             | 63, 69*                                                                                                                              | —                                     |
| 82. <i>Bearings — Unit 4</i>                                                     | 67*, 69*                                                                                                                             | —                                     |
| 83. <i>Pumps — Unit 5</i>                                                        | 60*                                                                                                                                  | —                                     |
| 84. <i>Piping Systems — Unit 6</i>                                               | 60*                                                                                                                                  | —                                     |
| 85. <i>Basic Hydraulics — Unit 7</i>                                             | 54, 55, 56, 57, 58, 59, 60*                                                                                                          | —                                     |
| 86. <i>Hydraulic Troubleshooting — Unit 8</i>                                    | 54*, 57, 59, 70*                                                                                                                     | —                                     |
| 87. <i>West Virginia Health and Safety Underground Mining Program</i>            | 2, 3*, 5, 9, 12, 14, 15, 17*, 23, 24, 27, 28, 30*, 32, 33, 34, 35, 37, 38, 41, 42, 43, 45, 46, 47, 64                                | 1*, 8*, 12, 17, 21*                   |

Table III — continued

| Instructional/Training Material                                                                                     | Competencies<br>Knowledges/Understandings                  | Abilities/Skills                        |
|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------|
| 88. <i>Coal Mining Series: Control of Mine Fires</i>                                                                | 5*, 17*, 21*, 22*, 23, 24*, 25*, 35, 36, 37, 38, 43, 44    | 6, 7, 8*, 13, 14, 15*, 17, 18*, 19*, 20 |
| 89. <i>Coal Mining Series: Safety Grounded System</i>                                                               | 16*, 48, 49, 50, 51, 52, 53, 66                            | 1*, 6*, 25, 26*, 27*, 28*, 39*          |
| 90. <i>Study Guide Series —<br/>Explosives and Blasting No. 5</i>                                                   | 12, 35, 36, 37, 38, 39, 40                                 | 13*, 14*, 17*, 19*, 20                  |
| 91. <i>Basic Electricity for Coal Miners — No. 6</i>                                                                | 48, 49, 50, 51*, 53*, 66*                                  | 17*, 25, 26, 28*, 39                    |
| 9. <i>Coal Mine Ventilation — No. 7</i>                                                                             | 12, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 29, 30 | 6, 7, 8*, 9*, 10*, 17*                  |
| 93. <i>Coal Mine Map Guide — No. 8</i>                                                                              | 2, 16*, 27, 28, 29, 30                                     | 1, 6*, 9, 10*, 13*                      |
| 94. <i>First Aid for Coal Miners — No. 10</i>                                                                       | 41                                                         | 16                                      |
| 95. <i>Final Exam — General Mining Course — No. 11</i>                                                              | —                                                          | —                                       |
| 96. <i>Mine Gases — No. 13</i>                                                                                      | 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 35*, 36, 40*   | 6, 7, 8, 13*, 15*                       |
| 97. <i>Practice Maps</i>                                                                                            | 28                                                         | 9                                       |
| 98. <i>The AC and DC's of Electric Motors</i>                                                                       | 48, 49, 51*                                                | —                                       |
| 99. <i>Industrial Fluid Power Text</i>                                                                              | 54, 55, 57*, 58, 59, 60*                                   | —                                       |
| 100. <i>Fluid Power in Plant and Field</i>                                                                          | 57*, 58, 70*                                               | —                                       |
| 101. <i>A.C. &amp; D.C. Generation</i>                                                                              | 48, 49                                                     | —                                       |
| 102. <i>An Introduction to Methane Gas</i>                                                                          | 12*, 16*, 17*, 18*, 22*, 23*                               | —                                       |
| 103. <i>Automation Comes to Coal</i>                                                                                | 4*, 64                                                     | —                                       |
| 104. <i>Basic Crimping Techniques</i>                                                                               | 45*                                                        | 21*, 25*                                |
| 105. <i>Basic Electricity</i>                                                                                       | 48, 49, 52*                                                | —                                       |
| 106. <i>Basic Hydraulics</i>                                                                                        | 54, 55, 58                                                 | —                                       |
| 107. <i>Basic Hydraulics</i>                                                                                        | 16*, 54*, 55*, 59*                                         | —                                       |
| 108. <i>Caritation</i>                                                                                              | 54*, 59                                                    | —                                       |
| 109. <i>The Canary Permissible Methane Detector<br/>by Bacharach</i>                                                | 24*, 42*, 45*                                              | 7*, 8*, 17*, 21*                        |
| 110. <i>11 CM Remote Control</i>                                                                                    | 50                                                         | —                                       |
| 111. <i>D.C. Coils in A.C. Linestarters</i>                                                                         | 49*, 50*, 52*                                              | 1*, 25*, 26*, 27*, 29*                  |
| 112. <i>Fire Suppression</i>                                                                                        | 37*, 38*                                                   | —                                       |
| 113. <i>Historic Development of the Flame<br/>Safety Lamp</i>                                                       | 24*, 45*                                                   | —                                       |
| 114. <i>How to Read an A.C. Wiring Diagram</i>                                                                      | 49*, 50*, 51*, 52*                                         | 1*, 25*, 29*                            |
| 115. <i>How to Read a Volt Ohmmeter</i>                                                                             | 49*                                                        | 25*                                     |
| 116. <i>Introduction to Longwall Mining</i>                                                                         | 15*                                                        | —                                       |
| 117. <i>Last Pony Mine, The</i>                                                                                     | 3*                                                         | —                                       |
| 118. <i>Longwall Mining</i>                                                                                         | 2*, 15*                                                    | —                                       |
| 119. <i>Motor Control for Joy's Roto Ripper Miner<br/>Introduction — The Role of the A-200<br/>Magnetic Starter</i> | 50*, 52*                                                   | 1*, 25*, 26*, 29*                       |
| 120. <i>MSA W-65 Self-Rescuer</i>                                                                                   | 17*, 23*, 42, 43                                           | 8*, 17*, 18*, 20*                       |
| 121. <i>Operation of the Drager 810 Self-Rescuer</i>                                                                | 23*, 43*                                                   | —                                       |
| 122. <i>Operation of the G-70 Methanometer</i>                                                                      | 24*, 45*                                                   | 7*, 21*                                 |
| 123. <i>Operation of the MSA Permissible Methane Spotter</i>                                                        | 16*, 24*, 25*, 45*                                         | 6*, 7*, 21*                             |

Table III — continued

| Instructional/Training Material                                         | Competencies<br>Knowledges/Understandings | Abilities/Skills   |
|-------------------------------------------------------------------------|-------------------------------------------|--------------------|
| 124. <i>Operation of the Riken Methane Indicator</i>                    | 16*, 24*                                  | 7*                 |
| 125. <i>Principles of Lubrication</i>                                   | 67*                                       | —                  |
| 126. <i>Purpose and Use of the Anemometer</i>                           | 29*, 45*                                  | 6*, 8*, 21*        |
| 127. <i>Target: Lower Cost Coal</i>                                     | 1*, 2*, 6*, 14*, 15*, 47*                 | —                  |
| 128. <i>Underground Longwall</i>                                        | 15                                        | —                  |
| 129. <i>The Use of the Permissible Flame Safety Lamp</i>                | 23, 24, 42*, 43*, 45*                     | 7, 8, 17, 18*, 21* |
| 130. <i>Axial Piston Pumps and Fluid Motors</i>                         | 54*, 60*                                  | —                  |
| 131. <i>Hydraulic Pressure Control Valves</i>                           | 54*, 60*                                  | —                  |
| 132. <i>Sound-on-Slide Electrical Programs</i>                          | 48, 49                                    | —                  |
| 133. <i>Sound-on-Slide General Programs</i>                             | 15, 27, 46, 47                            | —                  |
| 134. <i>Sound-on-Slide Hydraulic Programs</i>                           | 54, 55, 56, 57, 58, 59                    | —                  |
| 135. <i>Sound-on-Slide Mechanical Programs</i>                          | 63                                        | —                  |
| 136. <i>Your Worst Enemy</i>                                            | 42, 45                                    | 17                 |
| 137. <i>Contact That Kills</i>                                          | 12, 35, 37, 45                            | 17                 |
| 138. <i>Make the Roof Safe</i>                                          | —                                         | 17                 |
| 139. <i>The Fall Guys</i>                                               | —                                         | 17                 |
| 140. <i>A Breath in Time</i>                                            | 41                                        | 16                 |
| 141. <i>Fighting Coal-Mine Fires</i>                                    | 35, 38, 44                                | —                  |
| 142. <i>Plan for Survival</i>                                           | —                                         | 19, 20             |
| 143. <i>Roof Bolting in Coal Mines</i>                                  | 31, 32                                    | —                  |
| 144. <i>The Magic Of Fire</i>                                           | 35*                                       | —                  |
| 145. <i>Oh! My Aching Back</i>                                          | 42                                        | —                  |
| 146. <i>Causes and Prevention of Mine Fires and Explosions</i>          | 35, 37                                    | —                  |
| 147. <i>The Care and Use of a Permissible Flame Safety Lamp</i>         | 24                                        | 7                  |
| 148. <i>The First Minute</i>                                            | 41                                        | 16                 |
| 149. <i>Set the Pace</i>                                                | —                                         | 5, 19, 21          |
| 150. <i>Investigation — A Tool for Accident Prevention</i>              | —                                         | 17                 |
| 151. <i>Teach Safety</i>                                                | —                                         | 5                  |
| 152. <i>Sell Safety</i>                                                 | —                                         | —                  |
| 153. <i>Safety — A Way of Life</i>                                      | —                                         | —                  |
| 154. <i>Man and His Habits</i>                                          | 42*, 45                                   | —                  |
| 155. <i>Man's Shortcomings</i>                                          | 42*                                       | 5*                 |
| 156. <i>Safety Consciousness</i>                                        | —                                         | 5*                 |
| 157. <i>Motivation — A Means to Accident Prevention</i>                 | —                                         | 5*                 |
| 158. <i>Coal Miner — Today</i>                                          | 1*                                        | —                  |
| 159. <i>Preventing Coal Pneumoconiosis Through Engineering Controls</i> | 42*                                       | —                  |
| 160. <i>First Things First</i>                                          | 41                                        | 16                 |
| 161. <i>Who Is Right or Wrong?</i>                                      | —                                         | 17*                |
| 162. <i>Mine Rescue Contest Training</i>                                | 44                                        | —                  |
| 163. <i>Dangers Along Haulageways</i>                                   | —                                         | —                  |
| 164. <i>Electrical Equipment—Master or Servant</i>                      | —                                         | —                  |

Table III — continued

| Instructional/Training Material                        | Competencies<br>Knowledges/Understandings | Abilities/Skills |
|--------------------------------------------------------|-------------------------------------------|------------------|
| 165. Conveyor Belts — Be Careful                       | —                                         | 17*              |
| 166. Shuttle Car Operator                              | —                                         | 17*              |
| 167. Haulage Safety in Low-Coal Mines                  | —                                         | 17*              |
| 168. Safety Practices in Low-Coal Mining               | —                                         | 17               |
| 169. The Air We Breathe in Industrial Environments     | 42*                                       | —                |
| 170. Management's Role in Health and Safety            | 14*, 42*                                  | —                |
| 171. Emergency Investigation of Coal-Waste Embankments | 7*                                        | —                |
| 172. Mining Noise Hazards                              | 42*                                       | 17               |
| 173. Breathe and Live                                  | 27                                        | 7                |
| 174. Artificial Respiration                            | 41*, 42*                                  | 16*              |
| 175. Control of Bleeding                               | 42*                                       | 16*              |
| 176. Physical Shock                                    | 42*                                       | 16*              |
| 177. Open and Closed Wounds                            | 42*                                       | 16*              |
| 178. Burns and Scalds                                  | 42*                                       | 16*              |
| 179. Fractures and Dislocations                        | 42*                                       | 16*              |
| 180. Transportation                                    | 42*                                       | 16*              |
| 181. Cardiopulmonary Resuscitation                     | 42*                                       | 16*              |
| 182. Cabs and Canopies                                 | —                                         | 17*              |
| 183. Rubber-Tired Haulage                              | 47                                        | 17*              |
| 184. Underground Coal Mine Blasting                    | 39, 40                                    | —                |
| 185. Electrical Hazards in Underground Coal Mining     | —                                         | 17               |
| 186. Mine Emergency Operations (MEO)                   | —                                         | 19, 20           |
| 187. Assume Nothing                                    | 42*                                       | —                |
| 188. In Search of the Facts                            | 42*                                       | —                |
| 189. Safety on the Move                                | —                                         | —                |
| 190. Front-End Loader Safety                           | —                                         | 17*              |
| 191. Accident Prevention Through Equipment Guarding    | —                                         | 17               |
| 192. Electrical Lock-Out Procedures                    | —                                         | 17*              |
| 193. Safety in Longwall Mining                         | 15*                                       | 17*              |
| 194. Face Ventilation in Underground Coal Mines        | 27*                                       | 17*              |
| 195. Coal Mine Ventilation                             | 27                                        | 18               |
| 196. MSA W-65 Self-Rescuer                             | 42, 43                                    | 18               |
| 197. Permissible Drager 810 Respirator For Self Rescue | 42, 43                                    | 18               |
| 198. MSA Hydrogen Sulfide Detector                     | 24, 25                                    | —                |
| 199. MSA Nitrogen Dioxide Detector                     | 24, 25                                    | —                |
| 200. Permissible Methanometer G-70                     | 24, 25                                    | —                |
| 201. Permissible Methanometer M-402                    | 24, 25                                    | —                |
| 202. Permissible Methane Indicating Detector           | 24, 25                                    | —                |
| 203. MSA Permissible Methane Spotter                   | 24, 25                                    | —                |
| 204. Fundamentals of Noise Measurement                 | —                                         | 17*              |

Table III — continued

| Instructional/Training Material                                                        | Competencies<br>Knowledges/Understandings | Abilities/Skills |
|----------------------------------------------------------------------------------------|-------------------------------------------|------------------|
| 205. <i>Introduction to Courses in Oxygen Deficiency and Methane Detecting Devices</i> | 24                                        | —                |
| 206. <i>Riken Gas Indicator</i>                                                        | 24, 25                                    | —                |
| 207. <i>Monoxor Carbon Monoxide Indicator</i>                                          | 24, 25                                    | —                |
| 208. <i>MSA Explosimeter-Model 2A</i>                                                  | 24, 25                                    | —                |
| 209. <i>Koehler and Wolf Permissible Flame Safety Lamp</i>                             | 24, 25                                    | —                |
| 210. <i>Principles of Mine Rescue</i>                                                  | 44                                        | —                |
| 211. <i>Roof and Rib Control</i>                                                       | 32                                        | —                |
| 212. <i>MSA Carbon Monoxide Tester</i>                                                 | 24, 25                                    | —                |
| 213. <i>Mine Emergency Training</i>                                                    | 38                                        | 20               |
| 214. <i>Instructor Training Guide</i>                                                  | —                                         | —                |
| 215. <i>Job Safety Analysis Development</i>                                            | —                                         | —                |
| 216. <i>Safety Observations</i>                                                        | —                                         | —                |
| 217. <i>First Aid Instruction Course</i>                                               | 41                                        | 16               |
| 218. <i>Coal Mine Ventilation</i>                                                      | 27                                        | —                |
| 219. <i>MSA W-65 Self-Rescuer</i>                                                      | 43                                        | 18               |
| 220. <i>Permissible Drager 810 Respirator for Self Rescue</i>                          | 43                                        | 18               |
| 221. <i>MSA Hydrogen Sulfide Detector</i>                                              | 24                                        | —                |
| 222. <i>MSA Nitrogen Dioxide Detector</i>                                              | 24                                        | —                |
| 223. <i>Permissible Methanometer G-70</i>                                              | 24                                        | —                |
| 224. <i>Permissible Methanometer M-402</i>                                             | 24                                        | —                |
| 225. <i>Permissible Methane Indicating Detector</i>                                    | 24                                        | —                |
| 226. <i>MSA Permissible Methane Spotter</i>                                            | 24                                        | —                |
| 227. <i>Fundamentals of Noise Measurement</i>                                          | —                                         | 17               |
| 228. <i>Introduction to Courses in Oxygen Deficiency and Methane Detecting Devices</i> | 24                                        | —                |
| 229. <i>Riken Gas Indicator</i>                                                        | 24                                        | —                |
| 230. <i>Monoxor Carbon Monoxide Indicator</i>                                          | 24                                        | —                |
| 231. <i>MSA Explosimeter-Model 2A</i>                                                  | 24                                        | —                |
| 232. <i>Koehler and Wolf Permissible Flame Safety Lamps</i>                            | 24                                        | —                |
| 233. <i>Principles of Mine Rescue</i>                                                  | 44                                        | —                |
| 234. <i>Roof and Rib Control</i>                                                       | 32                                        | —                |
| 235. <i>MSA Carbon Monoxide Tester</i>                                                 | 24                                        | —                |
| 236. <i>Mine Emergency Training</i>                                                    | —                                         | 20               |
| 237. <i>Mine Rescue Training Using The Drager BG-174, 174A Breathing Apparatus</i>     | 44*                                       | —                |
| 238. <i>Mine Rescue Training Using the Auxiliary Rescue Apparatus-MSA Chemox</i>       | 44*                                       | —                |
| 239. <i>Mine Rescue Training Using the MSA McCAA Mine Rescue Apparatus</i>             | 44*                                       | —                |
| 240. <i>Instructor Training</i>                                                        | —                                         | —                |
| 241. <i>Job Safety Guide-Continuous Miner Operation</i>                                | —                                         | 35               |
| 242. <i>Job Safety Guide-Roof Bolting Operations</i>                                   | —                                         | 35               |

Table III — continued

| Instructional/Training Material                                                    | Competencies<br>Knowledges/Understandings | Abilities/Skills     |
|------------------------------------------------------------------------------------|-------------------------------------------|----------------------|
| 243. <i>Job Safety Guide-Shuttle Car Operation</i>                                 | —                                         | 35                   |
| 244. <i>Job Safety Guide-Trailing Cable Splicing</i>                               | —                                         | 35                   |
| 245. <i>Portable Fire Extinguisher</i>                                             | 38                                        | —                    |
| 246. <i>Rubber-Tired Front-End Loader with Fork Lift Truck Accident Prevention</i> | —                                         | 17*                  |
| 247. <i>CSE Permissible Digital Methanometer Model 100</i>                         | 24                                        | —                    |
| 248. <i>Job Safety Analysis Development</i>                                        | —                                         | 17                   |
| 249. <i>Safety Observations</i>                                                    | —                                         | 17                   |
| 250. <i>First Aid Instruction Course</i>                                           | 41                                        | 16                   |
| 251. <i>MSA W-65 Self-Rescuer</i>                                                  | 43                                        | 18                   |
| 252. <i>Permissible Drager 810 Respirator for Self Rescue</i>                      | 43                                        | 18                   |
| 253. <i>Permissible Methanometer G-70</i>                                          | 24                                        | —                    |
| 254. <i>Permissible Methanometer M-402</i>                                         | 24                                        | —                    |
| 255. <i>Permissible Methane Indicating Detector</i>                                | 24                                        | —                    |
| 256. <i>MSA Permissible Methane Spotter</i>                                        | 24                                        | —                    |
| 257. <i>MSA W-65 Self-Rescuer</i>                                                  | 43                                        | 18                   |
| 258. <i>Permissible Drager 810 Respirator for Self Rescue</i>                      | 43                                        | 18                   |
| 259. <i>Permissible Methanometer G-70</i>                                          | 24                                        | —                    |
| 260. <i>Permissible Methanometer M-402</i>                                         | 24                                        | —                    |
| 261. <i>Permissible Methane Indicating Detector</i>                                | 24                                        | —                    |
| 262. <i>MSA Permissible Methane Spotter</i>                                        | 24                                        | —                    |
| 263. <i>MSA W-65 Self Rescuer</i>                                                  | 43                                        | 18                   |
| 264. <i>Permissible Drager 810 Respirator For Self Rescue</i>                      | 43                                        | 18                   |
| 265. <i>MSA W-65 Self Rescuer</i>                                                  | 43                                        | 18                   |
| 266. <i>Permissible Drager 810 Respirator for Self Rescue</i>                      | 43                                        | 18                   |
| 267. <i>Permissible Methanometer G-70</i>                                          | 24                                        | —                    |
| 268. <i>Permissible Methane Indicating Detector</i>                                | 24                                        | —                    |
| 269. <i>MSA Permissible Methane Spotter</i>                                        | 24                                        | —                    |
| 270. <i>Permissible Methanometer M-502</i>                                         | 24                                        | —                    |
| 271. <i>An American Asset</i>                                                      | 1*, 2, 3*, 4* 5, 6, 7                     | —                    |
| 272. <i>The Invisible Power of Coal</i>                                            | 1, 2*, 5, 6                               | —                    |
| 273. <i>Electrical Permissibility</i>                                              | 12*, 22*, 35*, 37*, 48*, 50*, 51*         | —                    |
| 275. <i>Electrical Test and Measurement Instruments</i>                            | 16*, 45*, 49*                             | 21*                  |
| 275. <i>Troubleshooting Hydraulic Systems</i>                                      | 54*, 55*, 57*, 58*, 59*, 60*, 65*, 70*    | 31*                  |
| 276. <i>Basic Electric Arc Welding</i>                                             | 68*                                       | —                    |
| 277. <i>Oxyacetylene Welding</i>                                                   | 68*                                       | —                    |
| 278. <i>Proud To Be A Miner</i>                                                    | 10*                                       | —                    |
| 279. <i>Barricading</i>                                                            | —                                         | 8*, 20               |
| 280. <i>Escapeways</i>                                                             | 42*                                       | 8*, 17, 18*, 20, 21* |

Table III — continued

| Instructional/Training Material                                                              | Competencies<br>Knowledges/Understandings | Abilities/Skills |
|----------------------------------------------------------------------------------------------|-------------------------------------------|------------------|
| 281. <i>Geology of Coal</i>                                                                  | 5                                         | —                |
| 282. <i>An Introduction to Carbon Monoxide Gas</i>                                           | 17*, 23*, 43*                             | —                |
| 283. <i>Introduction to Underground Coal Mining<br/>Methods: Conventional and Continuous</i> | 2*, 15, 32, 46*, 47*, 64                  | —                |
| 284. <i>Introduction to Underground Coal Mining<br/>Methods: Longwall and Shortwall</i>      | 2*, 15, 46*, 47*                          | —                |
| 285. <i>Mine Ventilation Controls and<br/>Their Mine Map Symbols</i>                         | 2*, 27, 28, 29, 30                        | 9*               |
| 286. <i>The MSA Carbon Monoxide Spotter</i>                                                  | 17*, 24*, 45*                             | 7*, 21*          |
| 287. <i>Overcasts and Undercasts</i>                                                         | 2*, 27*, 28*, 30*                         | —                |
| 288. <i>Safety Grounded Systems</i>                                                          | 48, 49, 50*, 52, 53*                      | 17*, 25*         |
| 289. <i>Shuttle Car Operation</i>                                                            | 42, 45*, 46, 47, 64*                      | 17*, 21          |
|                                                                                              | # # #                                     |                  |

Table IV

### Inventory of Available Instructional/ Training Materials by Source

Table IV presents the fourth product of the project — an inventory of available instructional materials for coal miner training, listed alphabetically by source or vendor, and includes cost, if any, of each material. Materials are grouped in Table IV as follows:

- 1) instructional materials including textbooks, workbooks, data sheets, handbooks, manuals, maps, etc.;
- 2) audio-visual aids such as films, slide-tape programs, video cassette programs, transparencies, charts, posters, pocket cards, etc.;
- 3) teacher and student reference materials including State and Federal legislation related to coal mining, the 1978 Bituminous Coal Wage Agreement, publications of the Illinois State Geological Survey, the Keystone Coal Industry Manual, etc.;

- 4) miscellaneous reports, booklets and periodicals related to coal mining, and several small model kits for teaching basic electrical and hydraulic principles.

Several criteria were established for materials to be included in the inventory. The materials had to be 1) readily available, 2) usable at the secondary level in a classroom or lab/shop setting, 3) not specific to a particular make or model of mining machinery and 4) not prohibitively expensive.

A considerable amount of training material was excluded because it related to specific models of a manufacturer's products. Other materials such as simulators, table top mine models, and training programs were considered prohibitively expensive for secondary school mining curricula. Catalogs of several major mining machinery manufacturers were included in the materials turned over to DAVTE. These catalogs show the availability of those training materials excluded from the inventory because of machine/model specificity or prohibitive cost. A dot (•) preceding the title of an instructional material listed in Table IV indicates that a sample copy of the material was sent to DAVTE.

**Table IV. Inventory of Available Instructional/Training  
Materials by Source**

| Source of Material:                                                                                                                          | Title; Author; Description:                                                                                                                                           | Price:                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| <b>Instructional/Training Materials<br/>for Student Use</b><br>(Textbooks, Workbooks,<br>Handbooks, Manuals, etc.)                           |                                                                                                                                                                       |                                                                                 |
| 1. The American Institute of Mining,<br>Metallurgical and Petroleum<br>Engineers, Inc., New York, New York                                   | • <i>Elements of Practical Coal Mining.</i><br>Edited by Samuel M. Cassidy, 1973.<br>(Hardcover text, 614 pages)                                                      | AIME Member: \$12.00<br>Student Member: 8.50<br>Non-Member: 16.50               |
| 2. Chronicle Guidance Publications, Inc.<br>Moravia, New York 13118                                                                          | • <i>Mining Industry Occupations.</i><br>Occupational Brief, 3rd ed.<br>DOT 93, No. 187                                                                               | —                                                                               |
| 3. Coal Mine Training Materials, Inc.<br>6548-A Roosevelt Avenue, S.E.<br>Charleston, West Virginia                                          | • <i>Basic Coal Mining Workbook</i> by Frank<br>Kozak, Jr. (No text material. Oversize.<br>Essay, Fill-In, Mult. Choice, Matching<br>Completion-Questions, 218 pages) | \$7.00                                                                          |
| 4. Coal Mine Training Materials, Inc.                                                                                                        | • <i>Basic Workbook Practice Maps</i>                                                                                                                                 | \$ .25 each<br>#1-14                                                            |
| 5. Coal Mine Training Materials, Inc.                                                                                                        | • <i>Federal Underground Coal Mine Safety<br/>Laws</i> (Under revision) Softcover text.                                                                               | \$5.25                                                                          |
| 6. Coal Mine Training Materials, Inc.                                                                                                        | • <i>Map Workbook.</i> 1976 Edition, (145 pp.)                                                                                                                        | \$5.25                                                                          |
| 7. Coal Mine Training Materials, Inc.                                                                                                        | • <i>Practice Map Advanced Series</i>                                                                                                                                 | \$ .25 each<br>#1-13                                                            |
| 8. Coal Mine Training Materials, Inc.                                                                                                        | • <i>The Underground Supervisor</i> , 1976 Ed.<br>(Paragraph, Question & Answer<br>Format 137 pp.)                                                                    | \$5.25                                                                          |
| 9. DuPont Programmed<br>Instruction Courses<br>E.I. duPont de Nemours & Company<br>Applied Technology Division<br>Wilmington, Delaware 19898 | • <i>Plant Mathematics — Whole Numbers.</i><br>Course No. 29                                                                                                          | \$23.65 per student                                                             |
| 10. DuPont Programmed<br>Instruction Courses                                                                                                 | • <i>Reading Engineering Drawings.</i><br>Course No. 109                                                                                                              | \$20.65 per student                                                             |
| 11. General Motors Corporation<br>Public Relations Staff<br>Detroit, Michigan                                                                | • <i>ABC's of Hand Tools, Their Correct<br/>Usage and Care</i> , (Booklet, 47 pp.)                                                                                    | FREE-Single Copy                                                                |
| 12. Goodheart-Willcox Company, Inc.<br>123 West Taft Drive<br>South Holland, Illinois 60473                                                  | • <i>Basic Fundamentals of Arc Welding.</i><br>G-W Write-In Texts by John R. Walker<br>(128 pages)                                                                    | List Price: \$4.80<br>School Price: \$3.30                                      |
| 13. Goodheart-Willcox Company, Inc.                                                                                                          | • <i>Basic Fundamentals of Oxyacetylene<br/>Welding.</i> G-W Write-In Texts by<br>Ronald J. Baird, (104 pages)                                                        | List Price: \$4.40<br>School Price: \$3.30                                      |
| 14. Goodheart-Willcox Company, Inc.                                                                                                          | • <i>Basic Mathematics.</i> (Write-In Text)<br>by Walter C. Brown, Test-Sheets<br>for text. (127 pages)                                                               | List Price: \$3.68<br>School Price: \$2.76<br>Test sheets per set: \$.0-\$4.0   |
| 15. Goodheart-Willcox Company, Inc.                                                                                                          | • <i>Electricity</i> by Howard H. Gerrish<br>(Hardcover text, 120 pp.)                                                                                                | List Price: \$4.40<br>School Price: \$3.30                                      |
| 16. Goodheart-Willcox Company, Inc.                                                                                                          | • <i>Modern Carpentry.</i> (and accompanying<br>workbook) by Willis H. Wagner, 1976<br>(Hardcover text, 492 pages)                                                    | Text-List: \$11.92<br>School: \$8.94<br>Workbook-List: \$2.64<br>School: \$1.98 |
| 17. Goodheart-Willcox Company, Inc.                                                                                                          | • <i>Modern Masonry.</i> 1977 Edition by Clois<br>E. Kicklighter, (Hardcover text, 256 pp.)                                                                           | List Price: \$8.96<br>School Price: \$6.72                                      |
| 18. Goodheart-Willcox Company, Inc.                                                                                                          | • <i>Modern Welding</i> , 1976, by A.D. Althouse,<br>C.H. Turnquist, W.A. Bowditch,<br>(Hardcover text, 752 pp.)                                                      | List Price: \$11.92<br>School Price: \$8.94                                     |

Table IV — continued

| Source of Material:                                                      | Title; Author; Description:                                                                                               | Price:                                                |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 19. Joy Manufacturing Company<br>Franklin Penn. 16323                    | • <i>A Training Program for Alternating Current Mining Machinery.</i><br>(Softcover text, 76 pp.)                         | \$2.50                                                |
| 20. Joy Manufacturing Company                                            | • <i>A Training Program for Direct Current Mining Machinery.</i><br>(Softcover text, 162 pp.)                             | \$6.50                                                |
| 21. Joy Manufacturing Company                                            | • <i>Underground Mining — Vol. 1.</i><br>(Softcover text, 323 pp.)                                                        | \$14.95                                               |
| 22. MESA Instruction Guide 1<br>(MESA now MSHA)<br>(Revised April, 1975) | • <i>Coal Mine Ventilation.</i> (67 pp.)                                                                                  | FREE (MESA Materials are<br>free in limited quantity) |
| 23. MESA Instruction Guide 2<br>(Revised May, 1975)                      | • <i>MSA W-65 Self-Rescuer.</i> (13 pp.)                                                                                  | FREE                                                  |
| 24. MESA Instruction Guide 3<br>(Revised June, 1974)                     | • <i>Permissible Drager 810 Respirator<br/>for Self Rescue.</i> (9 pages)                                                 | FREE                                                  |
| 25. MESA Instruction Guide 4<br>(Revised April, 1972)                    | • <i>The MSA Hydrogen Sulfide Detector.</i><br>(33 pp.)                                                                   | FREE                                                  |
| 26. MESA Instruction Guide 5<br>(Revised June, 1974)                     | • <i>MSA Nitrogen Dioxide Detector.</i><br>(15 pp.)                                                                       | FREE                                                  |
| 27. MESA Instruction Guide 6<br>(Revised May, 1972)                      | • <i>G-70 Permissible Methanometer.</i><br>(34 pp.)                                                                       | FREE                                                  |
| 28. MESA Instruction Guide 7<br>(Revised January, 1975)                  | • <i>Permissible Methanometer M-402.</i><br>(19 pp.)                                                                      | FREE                                                  |
| 29. MESA Instruction Guide 8<br>(June, 1972)                             | • <i>Hand-Held Permissible Methane<br/>Indicating Detector.</i><br>Bacharach, (36 pp.)                                    | FREE                                                  |
| 30. MESA Instruction Guide 9<br>(Revised May, 1975)                      | • <i>MSA Permissible Methane Spotter.</i><br>(21 pp.)                                                                     | FREE                                                  |
| 31. MESA Instruction Guide 10<br>(April, 1973)                           | • <i>Fundamentals of Noise Measurement.</i><br>(21 pp.)                                                                   | FREE                                                  |
| 32. MESA Instruction Guide 11                                            | • <i>Introduction to Courses in Oxygen<br/>Deficiency and Methane Detecting<br/>Devices.</i> Revised Feb., 1976. (11 pp.) | FREE                                                  |
| 33. MESA Instruction Guide 12<br>(Revised February, 1976)                | • <i>Riken Gas Indicator Types 17, 18<br/>and 21.</i> (19 pp.)                                                            | FREE                                                  |
| 34. MESA Instruction Guide 13<br>(November, 1972)                        | • <i>Bacharach Monoxor Carbon<br/>Monoxide Indicator.</i> (46 pp.)                                                        | FREE                                                  |
| 35. MESA Instruction Guide 14                                            | • <i>MSA Explosimeter — Model 2A.</i><br>October, 1972. (27 pp.)                                                          | FREE                                                  |
| 36. MESA Instruction Guide 15<br>(Revised April, 1976)                   | • <i>Koehler and Wolf Permissible<br/>Flame Safety Lamps.</i> (27 pp.)                                                    | FREE                                                  |
| 37. MESA Instruction Guide 16<br>(Revised March, 1975)                   | • <i>Principles of Mine Rescue.</i> (94 pp.)                                                                              | FREE                                                  |
| 38. MESA Instruction Guide 17<br>(February, 1973)                        | • <i>Roof and Rib Control.</i> (85 pp.)                                                                                   | FREE                                                  |
| 39. MESA Instruction Guide 18<br>(November, 1972)                        | • <i>MSA Carbon Monoxide Tester.</i> (39 pp.)                                                                             | FREE                                                  |
| 40. MESA Instruction Guide 19<br>(September, 1972)                       | • <i>Mine Emergency Training.</i> (47 pp.)                                                                                | FREE                                                  |
| 41. MESA Instruction Guide 20<br>(Revised September, 1975)               | • <i>Audio Visual Guide.</i> (66 pp.)                                                                                     | FREE                                                  |
| 42. MESA Instruction Guide 21                                            | • <i>Mine Rescue Training Using the<br/>Drager BG 174, BG 174A Breathing<br/>Apparatus.</i> (46 pp.)                      | FREE                                                  |

Table IV — continued

| Source of Material:                                       | Title; Author; Description:                                                                                                                                | Price:                           |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 43. MESA Instruction Guide 22<br>(Revised December, 1975) | • <i>Mine Rescue Training Using the Auxiliary Rescue Apparatus MSA CHEMOX.</i> (35 pp.)                                                                    | FREE                             |
| 44. MESA Instruction Guide 23<br>(Revised December, 1975) | • <i>Mine Rescue Training Using the MSA McCaa Mine Rescue Apparatus.</i> (49 pp.)                                                                          | FREE                             |
| 45. MESA Instructor Training Guide 24                     | • Excerpts from the <i>Instructor Training Guide.</i> (50 pp.)                                                                                             | FREE                             |
| 46. MESA Instruction Guide 25<br>(April, 1973)            | • <i>Job Safety Guide — Continuous Miner.</i> (34 pp.)                                                                                                     | FREE                             |
| 47. MESA Instruction Guide 26<br>(August, 1973)           | • <i>Job Safety Guide — Roof-Bolting Operation.</i> (35 pp.)                                                                                               | FREE                             |
| 48. MESA Instruction Guide 27<br>(September, 1973)        | • <i>Job Safety Guide — Shuttle Car Operation.</i> (34 pp.)                                                                                                | FREE                             |
| 49. MESA Instruction Guide 28<br>(May, 1974)              | • <i>Job Safety Guide — Training Cable Splicing.</i> (46 pp.)                                                                                              | FREE                             |
| 50. MESA Instruction Guide 29<br>(March, 1975)            | • <i>Portable Fire Extinguishers.</i> (63 pp.)                                                                                                             | FREE                             |
| 51. MESA Instruction Guide 30<br>(October, 1975)          | • <i>Rubber-Tired Front End Loader and Fork Lift Truck Accident Prevention.</i>                                                                            | FREE                             |
| 52. MESA Instruction Guide 31<br>(May, 1975)              | • <i>CSE Permissible Digital Methanometer Model 100.</i> (11 pp.)                                                                                          | FREE                             |
| 53. MESA-Programmed<br>Instruction Workbook               | • <i>Mine Gases.</i> NMHSA-CE-002. (111 pp.)                                                                                                               | FREE                             |
| 54. MESA-Programmed<br>Instruction Workbook               | • <i>Roof and Rib Control—</i> NMHSA-CE-003. (91 pp.)                                                                                                      | FREE                             |
| 55. MESA-Programmed<br>Instruction Workbook               | • <i>First Aid — Volume I Workbook.</i> NMHSA-CE-006. (203 pp.)                                                                                            | FREE                             |
| 56. MESA-Programmed<br>Instruction Workbook               | • <i>Mine Illumination—</i> NMHSA-CE-008. (113 pp.)                                                                                                        | FREE                             |
| 57. MESA-Programmed<br>Instruction Workbook               | • <i>Electrical Hazards — Volume I Workbook.</i> (117 pp.) To be used with Vol. II Answer Book and Slide — Tape Presentation "Electrical Hazards — One"    | FREE                             |
| 58. MESA-Programmed<br>Instruction Workbook               | • <i>Coal Dust—</i> Volume I NMHSA-CE-009. (83 pp.)                                                                                                        | FREE                             |
| 59. MESA-Programmed<br>Instruction Workbook               | • <i>Noise Control</i> NMHSA-CE-011 (33 pp.)                                                                                                               | FREE                             |
| 60. MESA-Programmed<br>Instruction Workbook               | • <i>Coal Mining Safety Manual</i> 1. (34 pp.)                                                                                                             | FREE                             |
| 61. MESA-Programmed<br>Instruction Workbook               | • <i>Mine Gases Safety Manual</i> 2. (42 pp.)                                                                                                              | FREE                             |
| 62. MESA-Programmed<br>Instruction Workbook               | • <i>First Aid—Safety Manual No. 3.</i> (66 pp.)                                                                                                           | FREE                             |
| 63. MESA-Programmed<br>Instruction Workbook               | • <i>Accident Prevention—Safety Manual No. 4.</i> (38 pp.)                                                                                                 | FREE                             |
| 64. Science Research Associates, Inc.                     | • <i>SRA Occupational Brief—Coal Miners.</i> No. 51, D.O.T. 939.281 copyright 1977; 612 Mining and Mineral Products Industries, SRA Career Information Kit | (Part of Career Information Kit) |
| 65. Sperry Rand Corporation<br>Troy, Michigan 48084       | • <i>Sperry Vickers Mobile Hydraulics Manual.</i> M-2990 1st Edition, 1967, 8th Printing, Oct. 1974, (Softcover, 175 pp.)                                  | \$3.75                           |

Table IV — continued

| Source of Material:                                                                                                                                                                                                                                           | Title; Author; Description:                                                                                                                                                                                                                              | Price:                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| 66. The Pennsylvania State University<br>Mining Engineering Section<br>Department of Mineral Engineering<br>University Park, Penn.<br><br>TPC Training Systems<br>Div. of Technical Publishing Company<br>1301 South Grove Ave.<br>Barrington, Illinois 60010 | <ul style="list-style-type: none"> <li>• <i>New Miner Orientation Manual—An Instruction Training Manual.</i> (912 pp.) Mimeographed material—Softcover.</li> <li>• Lee Norse/Plant Engineering Training Program. (Set of Looseleaf notebooks)</li> </ul> | <p>FREE</p> <p>20 Volume Set<br/>\$451.00</p> |
| 67. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Introduction to Electricity &amp; Electronics, Unit 1.</i> (160 pp.), Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                  |                                               |
| 68. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Batteries and D-C Circuits—Unit 2.</i> (160 pp.) Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                       |                                               |
| 69. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Transformers and A-C Circuits—Unit 3.</i> (160 pp.) Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                    |                                               |
| 70. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Electrical Measuring Instruments—Unit 4.</i> (160 pp.), Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                |                                               |
| 71. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Electrical Protective Devices—Unit 5.</i> (160 pp.), Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                   |                                               |
| 72. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>D-C Equipment and Controls—Unit 6.</i> (160 pp.), Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                      |                                               |
| 73. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Single-Phase Motors—Unit 7.</i> (160 pp.) Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                              |                                               |
| 74. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Three-Phase Systems—Unit 8.</i> (160 pp.) Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                              |                                               |
| 75. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>A-C Control Equipment—Unit 9.</i> (160 pp.) Maintenance Plant Engineering Training Systems</li> </ul>                                                                                                        |                                               |
| 76. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Electrical Troubleshooting—Unit 10.</i> (160 pp.) Electrical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                      |                                               |
| 77. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Basic Blueprint Reading—Unit 1.</i> (160 pp.), Maintenance Fundamentals, Plant Engineering Training Systems</li> </ul>                                                                                       |                                               |
| 78. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Reading Schematics and Symbols—Unit 2.</i> (160 pp.) Maintenance Fundamentals, Plant Engineering Training Systems</li> </ul>                                                                                 |                                               |
| 79. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Elements of Mechanics—Unit 1.</i> (160 pp.) Mechanical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                            |                                               |
| 80. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Lubrication—Unit 2.</i> (160 pp.) Mechanical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                                      |                                               |
| 81. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Drive Components—Unit 3.</i> (160 pp.), Mechanical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                                |                                               |
| 82. TPC Training Systems                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• <i>Bearings—Unit 4.</i> (160 pp.) Mechanical Maintenance, Plant Engineering Training Systems</li> </ul>                                                                                                         |                                               |

Table IV — continued

| Source of Material:                                                | Title; Description:                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Price:   |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 83. TPC Training Systems                                           | • <i>Pumps—Unit 5.</i> (160 pp.)<br>Mechanical Maintenance, Plant<br>Engineering Training Systems                                                                                                                                                                                                                                                                                                                                                                                     |          |
| 84. TPC Training Systems                                           | • <i>Piping Systems—Unit 6.</i> (160 pp.)<br>Mechanical Maintenance, Plant<br>Engineering Training Systems                                                                                                                                                                                                                                                                                                                                                                            |          |
| 85. TPC Training Systems                                           | • <i>Basic Hydraulics—Unit 7.</i> (160 pp.)<br>Mechanical Maintenance, Plant<br>Engineering Training Systems                                                                                                                                                                                                                                                                                                                                                                          |          |
| 86. TPC Training Systems                                           | • <i>Hydraulic Troubleshooting—Unit 8.</i><br>(160 pp.), Mechanical Maintenance, Plant<br>Engineering Training Systems                                                                                                                                                                                                                                                                                                                                                                |          |
| 87. West Virginia Department of Mines<br>Charleston, West Virginia | • <i>West Virginia Health and Safety<br/>Underground Mining Program.</i> (Revised<br>Edition Softcover materials) 80-hour<br>Program includes: Instructor's Guides<br>(One copy of each), I, II, III, IV, and<br>Sound/Slide Programs Guide, Student<br>Guide (2 copies), Slides for All Teaching<br>Units (1,057 slides) Slide/Tape Pro-<br>grams (4 Cassette Tapes and 250 Slides),<br>Transparencies (set of seven), Progress<br>checks, Answer Keys and Handout<br>Sheets (1 set) | \$434.55 |
| 88. West Virginia University<br>Mining Extension Service           | • <i>Coal Mining Series: Control of Mine Fires.</i><br>by John J. Dougherty. (SC text, 89 pp.)                                                                                                                                                                                                                                                                                                                                                                                        | \$2.00   |
| 89. West Virginia University<br>Mining Extension Service           | • <i>Coal Mining Series: Safety Grounded<br/>System.</i> by Gary Powell,<br>(Softcover text, 88 pp.)                                                                                                                                                                                                                                                                                                                                                                                  | \$2.00   |
| 90. West Virginia University<br>Mining Extension Service           | • <i>Study Guide Series.</i> (Question-answer<br>format softcover materials)                                                                                                                                                                                                                                                                                                                                                                                                          |          |
|                                                                    | • <i>Explosives and Blasting—No. 5.</i> (29 pp.)                                                                                                                                                                                                                                                                                                                                                                                                                                      | \$ .50   |
| 91. West Virginia University<br>Mining Extension Service           | • <i>Basic Electricity for Coal Miners—No. 6.</i><br>(18 pp.)                                                                                                                                                                                                                                                                                                                                                                                                                         | \$ .60   |
| 92. West Virginia University<br>Mining Extension Service           | • <i>Coal Mine Ventilation—No. 7.</i> (42 pp.)                                                                                                                                                                                                                                                                                                                                                                                                                                        | \$ .80   |
| 93. West Virginia University<br>Mining Extension Service           | • <i>Coal Mine Map Guide—No. 8.</i><br>(77 pp.)                                                                                                                                                                                                                                                                                                                                                                                                                                       | \$2.00   |
| 94. West Virginia University<br>Mining Extension Service           | • <i>First Aid for Coal Miners—No. 10.</i><br>(25 pp.)                                                                                                                                                                                                                                                                                                                                                                                                                                | \$ .60   |
| 95. West Virginia University<br>Mining Extension Service           | • <i>Final Exam—General Mining Course—<br/>No. 11.</i> (96 pp.) Contains questions and<br>multiple choice answers in the following<br>areas: mine gases, ventilation, general<br>mining practice, electricity, explosives,<br>mine fires and explosions, instruments<br>and apparatus, first aid, records and<br>transportation                                                                                                                                                       | \$1.50   |
| 96. West Virginia University<br>Mining Extension Service           | • <i>Mine Gases—No. 13.</i> (41 pp.)                                                                                                                                                                                                                                                                                                                                                                                                                                                  | \$1.00   |
| 97. West Virginia University<br>Mining Extension Service           | • <i>Practice Maps.</i> TM-101, TM-102,<br>TM-103, TM-104, TM-105, TM-106                                                                                                                                                                                                                                                                                                                                                                                                             |          |

Table IV — continued

| Source of Material:                                                         | Title; Description:                                                                                                                                           | Price:                                                      |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| 98. Westinghouse Electric Corporation<br>Small Motor Division<br>Lima, Ohio | • <i>The AC and DC's of Electric Motors</i> ,<br>(Softcover text, 33 pp.)                                                                                     | \$3.50                                                      |
| 99. Womack Education Publications<br>2010 Shea Road<br>Dallas, Texas 75235  | • <i>Industrial Fluid Power Text</i> . Vol. 1<br>Second Edition (Softcover text, 240 pp.)<br>November, 1977. Set of 216 slides to<br>accompany text           | Text: \$7.90<br>Teacher's Guide: \$1.50<br>Slides: \$103.00 |
| 100. Womack Education Publications                                          | • <i>Fluid Power in Plant and Field</i> ,<br>by Charles S. Hedges and R.C. Womack<br>Copyright 1968, Ninth printing January<br>1978 (Softcover text, 176 pp.) | \$6.85                                                      |

**Audio-Visual Aids**  
(Films, slide-tape programs, video cassette  
transparencies, flip charts, programs,  
posters, etc.)

|                                                       |                                                                                                   |          |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------|
| 101. Joy Manufacturing Company<br>Franklin, Pa. 16323 | <i>A.C. &amp; D.C. Generation</i> . 16mm Film-<br>color, sound, 20 minutes                        | \$275.00 |
| 102. Joy Manufacturing Company                        | • <i>An Introduction to Methane Gas</i> . Slide-<br>Tape Program, 31 slides                       | \$57.50  |
| 103. Joy Manufacturing Company                        | <i>Automation Comes to Coal</i> . 10 min.<br>16mm Film-color, sound                               | \$250.00 |
| 104. Joy Manufacturing Company                        | <i>Basic Crimping Techniques</i> . Slide-Tape<br>Program; Text—\$1.00                             | \$175.00 |
| 105. Joy Manufacturing Company                        | <i>Basic Electricity</i> .<br>16mm Film-color, sound                                              | \$275.00 |
| 106. Joy Manufacturing Company                        | <i>Basic Hydraulics</i> . 16mm Film-<br>color, sound 15 minutes                                   | \$250.00 |
| 107. Joy Manufacturing Company                        | <i>Basic Hydraulics</i> . Slide-Tape Program,<br>30 slides, Text \$2.50                           | \$180.00 |
| 108. Joy Manufacturing Company                        | <i>Cavitation</i> . 16mm Film-color,<br>sound, 18 minutes                                         | \$285.00 |
| 109. Joy Manufacturing Company                        | <i>The Canary Permissible Methane<br/>Detector by Bacharach</i> . Slide-tape<br>Program 21 slides | \$57.50  |
| 110. Joy Manufacturing Company                        | <i>11 CM Remote Control</i> . Super 8 Film, 8mm                                                   |          |
| 111. Joy Manufacturing Company                        | <i>D.C. Coils in A.C. Linestarters</i> .<br>Slide-tape program—42 slides; Text—\$2.00             | \$225.00 |
| 112. Joy Manufacturing Company                        | <i>Fire Suppression</i> . (Electrical General),<br>Slide-tape program, 80 slides                  | \$265.00 |
| 113. Joy Manufacturing Company                        | • <i>Historic Development of the Flame Safety<br/>Lamp</i> . Slide-tape program, 58 slides        | \$177.50 |
| 114. Joy Manufacturing Company                        | <i>How to Read an A.C. Wiring Diagram</i> .<br>slide-tape program; Text—\$1.75, 151 slides        | \$535.00 |
| 115. Joy Manufacturing Company                        | <i>How to Read a Volt Ohmmeter</i> . Slide-tape<br>program, 118 slides; Text—\$1.00               | \$235.00 |
| 116. Joy Manufacturing Company                        | <i>Introduction to Longwall Mining</i> .<br>Slide-tape program, 78 slides                         | \$145.00 |
| 117. Joy Manufacturing Company                        | <i>Last Pony Mine, The</i> .<br>16mm Film-color, sound                                            | \$330.00 |
| 118. Joy Manufacturing Company                        | • <i>Longwall Mining</i> . 16mm Film-color,<br>sound 30 minutes                                   | \$375.00 |

Table IV — continued

| Source of Material:                                                                | Title; Description:                                                                                                                                                         | Price:             |                           |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------|
| 119. Joy Manufacturing Company                                                     | <i>Motor Control for Joy's Roto Ripper Miner Introduction—The Role of the A-200 Magnetic Starter.</i> Slide-tape program, 65 slides; Text-\$1.50                            | \$225.00           |                           |
| 120. Joy Manufacturing Company                                                     | <i>MSA W-65 Self-Rescuer.</i> Slide-tape program, 31 slides                                                                                                                 | \$57.50            |                           |
| 121. Joy Manufacturing Company                                                     | <i>Operation of the Drager 810 Self-Rescuer.</i> Slide-tape program, 26 slides                                                                                              | \$57.50            |                           |
| 122. Joy Manufacturing Company                                                     | <i>Operation of the G-70 Methanometer.</i> Slide-tape program, 23 slides                                                                                                    | \$57.50            |                           |
| 123. Joy Manufacturing Company                                                     | <i>Operation of the MSA Permissible Methane Spotter.</i> Slide-tape program, 19 slides                                                                                      | \$57.50            |                           |
| 124. Joy Manufacturing Company                                                     | <i>Operation of the Riken Methane Indicator.</i> Slide-tape program, 26 slides                                                                                              | \$57.50            |                           |
| 125. Joy Manufacturing Company                                                     | <i>Principles of Lubrication.</i> 16mm Film, black and white, 12 minutes                                                                                                    | \$185.00           |                           |
| 126. Joy Manufacturing Company                                                     | <i>Purpose and Use of the Anemometer.</i> (all types) Slide-tape program, 50 slides                                                                                         | \$115.00           |                           |
| 127. Joy Manufacturing Company                                                     | • <i>Target: Lower Cost Coal.</i> 16mm Film-color, sound, 23 minutes                                                                                                        | \$250.00           |                           |
| 128. Joy Manufacturing Company                                                     | <i>Underground Longwall.</i> Super 8 film                                                                                                                                   | \$187.00           |                           |
| 129. Joy Manufacturing Company                                                     | <i>The Use of the Permissible Flame Safety Lamp.</i> Slide-tape program, 70 slides                                                                                          | \$177.50           |                           |
| 130. Lee-Norse Training Department<br>751 Lincoln Avenue<br>Charleroi, Penn. 15022 | <i>Axial Piston Pumps and Fluid Motors.</i> 16mm, Film-color, sound, 20 minutes                                                                                             | \$343.60           |                           |
| 131. Lee-Norse Training Department                                                 | <i>Hydraulic Pressure Control Valves.</i> 16mm Film-color, sound, 30 minutes                                                                                                | \$501.40           |                           |
| 132. Lee-Norse Training Department                                                 | <i>Sound-on-Slide Electrical Programs.</i> Circuit Trays, Electric Component Trays, Electric General Trays, (Requires the use of a projector/recorder such as 3M Model 625) | \$130.30 each part |                           |
| 133. Lee-Norse Training Department                                                 | <i>Sound-on-Slide General Programs.</i> (in varying stages of development)                                                                                                  | \$130.30 each part |                           |
| 134. Lee-Norse Training Department                                                 | <i>Sound-on-Slide Hydraulic Programs.</i> (Hydraulic Circuit Trays, Hydraulic Component Trays, Hydraulic General Trays)                                                     | \$130.30 each part |                           |
| 135. Lee-Norse Training Department                                                 | <i>Sound-on-Slide Mechanical Programs.</i>                                                                                                                                  | \$130.30 each part |                           |
| 136. MESA Training Films/and Video<br>Cassette Programs                            | <i>Your Worst Enemy.</i> 25 minutes                                                                                                                                         | Film<br>\$116.24   | Video Cassette<br>\$55.00 |
| 137. MESA Training Films/Video Cassettes                                           | <i>Contact That Kills.</i> 21 minutes                                                                                                                                       | \$ 94.85           | \$55.00                   |
| 138. MESA Training Films/Video Cassettes                                           | <i>Make the Roof Safe.</i> 26 minutes                                                                                                                                       | \$115.48           | \$55.00                   |
| 139. MESA Training Films/Video Cassettes                                           | <i>The Fall Guys.</i> 20 minutes                                                                                                                                            | \$ 92.38           | \$45.00                   |
| 140. MESA Training Films/Video Cassettes                                           | <i>A Breath in Time.</i> 27 minutes                                                                                                                                         | \$124.89           | \$55.00                   |
| 141. MESA Training Films/Video Cassettes                                           | <i>Fighting Coal-Mine Fires.</i> 31 minutes                                                                                                                                 | \$146.79           | \$60.00                   |
| 142. MESA Training Films/Video Cassettes                                           | <i>Plan for Survival.</i> 34 minutes                                                                                                                                        | \$157.16           | \$60.00                   |
| 143. MESA Training Films/Video Cassettes                                           | <i>Roof Bolting in Coal Mines.</i> (Revised), 19 min.                                                                                                                       | \$ 85.10           | \$45.00                   |

Table IV — continued

| Source of Material:                      | Title; Description:                                                             | Price:<br>Film | Video Cassette |
|------------------------------------------|---------------------------------------------------------------------------------|----------------|----------------|
| 144. MESA Training Films/Video Cassettes | <i>The Magic of Fire</i> . 23 minutes                                           | \$106.12       | \$55.00        |
| 145. MESA Training Films/Video Cassettes | <i>Oh! My Aching Back</i> . 21 minutes                                          | \$106.06       | \$45.00        |
| 146. MESA Training Films/Video Cassettes | <i>Causes and Prevention of Mine Fires and Explosions</i> . 27 minutes          | \$135.92       | \$55.00        |
| 147. MESA Training Films/Video Cassettes | <i>The Care and Use of a Permissible Flame Safety Lamp</i> . 28 minutes         | \$138.78       | \$55.00        |
| 148. MESA Training Films/Video Cassettes | <i>The First Minute</i> . 18 minutes                                            | \$ 93.85       | \$45.00        |
| 149. MESA Training Films/Video Cassettes | <i>Set the Pace</i> . 10 minutes                                                | \$ 48.82       | \$35.00        |
| 150. MESA Training Films/Video Cassettes | <i>Investigation — A Tool for Accident Prevention</i> . 7 minutes               | \$ 36.20       | \$35.00        |
| 151. MESA Training Films/Video Cassettes | <i>Teach Safety</i> . 15 minutes                                                | \$ 71.81       | \$40.00        |
| 152. MESA Training Films/Video Cassettes | <i>Sell Safety</i> . 10 minutes                                                 | \$ 49.20       | \$35.00        |
| 153. MESA Training Films/Video Cassettes | <i>Safety—A Way of Life</i> . 21 minutes                                        | \$102.29       | \$55.00        |
| 154. MESA Training Films/Video Cassettes | <i>Man and His Habits</i> . 13 minutes                                          | \$ 63.35       | \$40.00        |
| 155. MESA Training Films/Video Cassettes | <i>Man's Shortcomings</i> . 13 minutes                                          | \$ 61.28       | \$40.00        |
| 156. MESA Training Films/Video Cassettes | <i>Safety Consciousness</i> . 10 minutes                                        | \$ 47.38       | \$35.00        |
| 157. MESA Training Films/Video Cassettes | <i>Motivation — A Means to Accident Prevention</i> . 11 minutes                 | \$ 56.22       | \$40.00        |
| 158. MESA Training Films/Video Cassettes | <i>Coal Miner Today</i> . (Revised), 14 minutes                                 | \$ 71.37       | \$40.00        |
| 159. MESA Training Films/Video Cassettes | <i>Preventing Coal Pneumoconiosis Through Engineering Controls</i> . 21 minutes | \$ 98.91       | \$45.00        |
| 160. MESA Training Films/Video Cassettes | <i>First Things First</i> . 29 minutes                                          | \$145.28       | \$55.00        |
| 161. MESA Training Films/Video Cassettes | <i>Who Is Right or Wrong?</i> 22 minutes                                        | \$ 96.70       | \$55.00        |
| 162. MESA Training Films/Video Cassettes | <i>Mine Rescue Contest Training</i> . 25 minutes                                | \$125.13       | \$55.00        |
| 163. MESA Training Films/Video Cassettes | <i>Dangers Along Haulageways</i> . 22 minutes                                   | \$107.24       | \$55.00        |
| 164. MESA Training Films/Video Cassettes | <i>Electrical Equipment—Master or Servant</i> . 18 minutes                      | \$ 93.71       | \$45.00        |
| 165. MESA Training Films/Video Cassettes | <i>Conveyor Belts—Be Careful</i> . 15 minutes                                   | \$ 75.19       | \$40.00        |
| 166. MESA Training Films/Video Cassettes | <i>Shuttle Car Operator</i> . 20 minutes                                        | \$ 96.70       | \$45.00        |
| 167. MESA Training Films/Video Cassettes | <i>Haulage Safety in Low-Coal Mines</i> . 15 min.                               | \$ 70.51       | \$40.00        |
| 168. MESA Training Films/Video Cassettes | <i>Safety Practices in Low-Coal Mining</i> . 15 minutes                         | \$ 79.48       | \$40.00        |
| 169. MESA Training Films/Video Cassettes | <i>The Air We Breathe in Industrial Environments</i> . 16 minutes               | \$ 81.42       | \$45.00        |
| 170. MESA Training Films/Video Cassettes | <i>Management's Role in Health and Safety</i> . 15 minutes                      | \$ 72.59       | \$40.00        |
| 171. MESA Training Films/Video Cassettes | <i>Emergency Investigation of Coal-Waste Embankments</i> . 16 minutes           | \$ 71.79       | \$45.00        |
| 172. MESA Training Films/Video Cassettes | <i>Mining Noise Hazards</i> . 21 minutes                                        | \$100.80       | \$55.00        |
| 173. MESA Training Films/Video Cassettes | <i>Breathe and Live</i> . 21 minutes                                            | \$ 96.22       | \$55.00        |
| 174. MESA Training Films/Video Cassettes | <i>Artificial Respiration</i> . 9 minutes                                       | \$ 45.56       | \$35.00        |
| 175. MESA Training Films/Video Cassettes | <i>Control of Bleeding</i> . 13 minutes                                         | \$ 60.90       | \$40.00        |
| 176. MESA Training Films/Video Cassettes | <i>Physical Shock</i> . 9 minutes                                               | \$ 41.35       | \$35.00        |
| 177. MESA Training Films/Video Cassettes | <i>Open and Closed Wounds</i> . 9 minutes                                       | \$ 43.33       | \$35.00        |
| 178. MESA Training Films/Video Cassettes | <i>Burns and Scalds</i> . 7 minutes                                             | \$ 32.69       | \$35.00        |

Table IV — continued

| Source of Material:                      | Title; Description:                                                                                                               | Price:<br>Film | Video Cassette |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|
| 179. MESA Training Films/Video Cassettes | <i>Fractures and Dislocations.</i> 11 minutes                                                                                     | \$ 51.26       | \$40.00        |
| 180. MESA Training Films/Video Cassettes | <i>Transportation.</i> 8 minutes                                                                                                  | \$ 36.79       | \$35.00        |
| 181. MESA Training Films/Video Cassettes | <i>Cardiopulmonary Resuscitation.</i><br>19 minutes                                                                               | \$ 88.32       | \$45.00        |
| 182. MESA Training Films/Video Cassettes | <i>Cabs and Canopies.</i> 10 minutes                                                                                              | \$ 52.11       | \$35.00        |
| 183. MESA Training Films/Video Cassettes | <i>Rubber-Tired Haulage.</i> 14 minutes                                                                                           | \$ 65.62       | \$40.00        |
| 184. MESA Training Films/Video Cassettes | <i>Underground Coal Mine Blasting.</i><br>19 minutes                                                                              | \$ 86.33       | \$45.00        |
| 185. MESA Training Films/Video Cassettes | <i>Electrical Hazards in Underground<br/>Coal Mining.</i> 13 minutes                                                              | \$ 60.67       | \$40.00        |
| 186. MESA Training Films/Video Cassettes | <i>Mine Emergency Operations (MEO).</i><br>17 minutes                                                                             | \$ 91.71       | \$45.00        |
| 187. MESA Training Films/Video Cassettes | <i>Assume Nothing.</i> 21 minutes                                                                                                 | \$ 94.99       | \$55.00        |
| 188. MESA Training Films/Video Cassettes | <i>In Search of the Facts.</i> 26 minutes                                                                                         | \$134.24       | \$55.00        |
| 189. MESA Training Films/Video Cassettes | <i>Safety on the Move.</i> 16 minutes                                                                                             | \$ 86.93       | \$45.00        |
| 190. MESA Training Films/Video Cassettes | <i>Front-End Loader Safety.</i> 14 minutes                                                                                        | \$ 74.06       | \$40.00        |
| 191. MESA Training Films/Video Cassettes | <i>Accident Prevention Through<br/>Equipment Guarding.</i> 11 minutes                                                             | \$ 51.00       | \$40.00        |
| 192. MESA Training Films/Video Cassettes | <i>Electrical Lock-Out Procedures.</i><br>11 minutes                                                                              | \$ 52.11       | \$40.00        |
| 193. MESA Training Films/Video Cassettes | <i>Safety in Longwall Mining.</i> 18 minutes                                                                                      | \$ 94.00       | \$45.00        |
| 194. MESA Training Films/Video Cassettes | <i>Face Ventilation in Underground<br/>Coal Mines.</i>                                                                            | In production  |                |
| 195. MESA (IG 1)                         | <i>Coal Mine Ventilation.</i> Overhead trans-<br>parencies, 34 visuals                                                            | \$32.40        |                |
| 196. MESA (IG 2)                         | <i>MSA W-65 Self-Rescuer.</i> Overhead<br>transparencies, 12 visuals                                                              | \$10.35        |                |
| 197. MESA (IG 3)                         | <i>Permissible Drager 810 Respirator for<br/>Self Rescue.</i> Overhead transparencies,<br>10 visuals                              | \$ 8.65        |                |
| 198. MESA (IG 4)                         | <i>MSA Hydrogen Sulfide Detector.</i><br>Overhead transparencies, 16 visuals                                                      | \$15.20        |                |
| 199. MESA (IG 5)                         | <i>MSA Nitrogen Dioxide Detector.</i><br>Overhead transparencies, 18 visuals                                                      | \$15.75        |                |
| 200. MESA (IG 6)                         | <i>Permissible Methanometer G-70.</i><br>Overhead transparencies, 16 visuals                                                      | \$13.80        |                |
| 201. MESA (IG 7)                         | <i>Permissible Methanometer M-402.</i><br>Overhead transparencies, 10 visuals                                                     | \$ 8.65        |                |
| 202. MESA (IG 8)                         | <i>Permissible Methane Indicating Detector.</i><br>Overhead transparencies, 14 visuals                                            | \$12.10        |                |
| 203. MESA (IG 9)                         | <i>MSA Permissible Methane Spotter.</i><br>Overhead transparencies, 16 visuals                                                    | \$13.80        |                |
| 204. MESA (IG 10)                        | <i>Fundamentals of Noise Measurement.</i><br>Overhead transparencies, 31 visuals                                                  | \$33.50        |                |
| 205. MESA (IG 11)                        | <i>Introduction to Courses in Oxygen<br/>Deficiency and Methane Detecting<br/>Devices.</i> Overhead transparencies,<br>11 visuals | \$12.00        |                |
| 206. MESA (IG 12)                        | <i>Riken Gas Indicator.</i> Overhead trans-<br>parencies, 14 visuals                                                              | \$13.60        |                |

Table IV — continued

| Source of Material: | Title; Description:                                                                                        | Price:  |
|---------------------|------------------------------------------------------------------------------------------------------------|---------|
| 207. MESA (IG 13)   | <i>Monoxor Carbon Monoxide Indicator.</i><br>Overhead transparencies, 17 visuals                           | \$20.15 |
| 208. MESA (IG 14)   | <i>MSA Explosimeter-Model 2A.</i><br>Overhead transparencies, 9 visuals                                    | \$11.85 |
| 209. MESA (IG 15)   | <i>Koehler and Wolf Permissible Flame Safety Lamp.</i> Overhead transparencies, 24 visuals                 | \$23.75 |
| 210. MESA (IG 16)   | <i>Principles of Mine Rescue.</i><br>Overhead transparencies, 36 visuals                                   | \$41.45 |
| 211. MESA (IG 17)   | <i>Roof and Rib Control.</i> Overhead transparencies, 22 visuals                                           | \$27.35 |
| 212. MESA (IG 18)   | <i>MSA Carbon Monoxide Tester.</i><br>Overhead transparencies, 21 visuals                                  | \$26.40 |
| 213. MESA (IG 19)   | <i>Mine Emergency Training.</i><br>Overhead transparencies, 15 visuals                                     | \$18.95 |
| 214. MESA (IG 24)   | <i>Instructor Training Guide.</i><br>Overhead transparencies, 8 visuals                                    | \$11.60 |
| 215. MESA (IG 32C)  | <i>Job Safety Analysis Development.</i><br>Overhead transparencies, 46 visuals                             | \$50.00 |
| 216. MESA (IG 32D)  | <i>Safety Observations.</i><br>Overhead transparencies, 26 visuals                                         | \$30.00 |
| 217. MESA           | <i>First Aid Instruction Course.</i><br>Overhead transparencies, 73 visuals                                | \$24.45 |
| 218. MESA (IG 1)    | <i>Coal Mine Ventilation.</i><br>35mm Slides, 34 visuals                                                   | \$ 3.95 |
| 219. MESA (IG 2)    | <i>MSA W-65 Self-Rescuer.</i><br>35mm Slides, 12 visuals                                                   | \$ 2.25 |
| 220. MESA (IG 3)    | <i>Permissible Drager 810 Respirator for Self Rescue.</i> 35mm Slides, 10 visuals                          | \$ 1.75 |
| 221. MESA (IG 4)    | <i>MSA Hydrogen Sulfide Detector.</i><br>35mm Slides, 16 visuals                                           | \$ 2.75 |
| 222. MESA (IG 5)    | <i>MSA Nitrogen Dioxide Detector.</i><br>35mm Slides, 18 visuals                                           | \$ 3.10 |
| 223. MESA (IG 6)    | <i>Permissible Methanometer G-70.</i><br>35 Slides, 16 visuals                                             | \$ 1.85 |
| 224. MESA (IG 7)    | <i>Permissible Methanometer M-402.</i><br>35mm Slides, 10 visuals                                          | \$ 1.95 |
| 225. MESA (IG 8)    | <i>Permissible Methane Indicating Detector.</i><br>35mm Slides, 14 visuals                                 | \$ 1.60 |
| 226. MESA (IG 9)    | <i>MSA Permissible Methane Spotter.</i><br>35mm Slides, 16 visuals                                         | \$ 1.85 |
| 227. MESA (IG 10)   | <i>Fundamentals of Noise Measurement.</i><br>35mm Slides, 31 visuals                                       | \$ 5.25 |
| 228. MESA (IG 11)   | <i>Introduction to Courses in Oxygen Deficiency and Methane Detecting Devices.</i> 35mm Slides, 11 visuals | \$ 2.50 |
| 229. MESA (IG 12)   | <i>Riken Gas Indicator.</i><br>35mm Slides, 14 visuals                                                     | \$ 2.75 |
| 230. MESA (IG 13)   | <i>Monoxor Carbon Monoxide Indicator.</i><br>35mm Slides, 17 visuals                                       | \$ 2.95 |
| 231. MESA (IG 14)   | <i>MSA Explosimeter-Model 2A.</i><br>35mm Slides, 9 visuals                                                | \$ 2.00 |

Table IV — continued

| Source of Material: | Title; Description:                                                                                    | Price:  |
|---------------------|--------------------------------------------------------------------------------------------------------|---------|
| 232. MESA (IG 15)   | <i>Koehler and Wolf Permissible Flame Safety Lamps.</i> 35mm Slides, 24 visuals                        | \$ 4.10 |
| 233. MESA (IG 16)   | <i>Principles of Mine Rescue.</i> 35mm Slides, 36 visuals                                              | \$ 6.00 |
| 234. MESA (IG 17)   | <i>Roof and Rib Control.</i> 35mm Slides, 22 visuals                                                   | \$ 2.65 |
| 235. MESA (IG 18)   | <i>MSA Carbon Monoxide Tester.</i> 35mm Slides, 21 visuals                                             | \$ 3.85 |
| 236. MESA (IG 19)   | <i>Mine Emergency Training.</i> 35mm Slides, 15 visuals                                                | \$ 2.95 |
| 237. MESA (IG 21)   | <i>Mine Rescue Training Using The Drager BG-174, 174A Breathing Apparatus.</i> 35mm Slides, 66 visuals | \$ 9.50 |
| 238. MESA (IG 22)   | <i>Mine Rescue Training Using the Auxiliary Rescue Apparatus-MSA Chemox.</i> 35mm Slides, 36 visuals   | \$ 3.75 |
| 239. MESA (IG 23)   | <i>Mine Rescue Training Using the MSA McCAA Mine Rescue Apparatus.</i> 35mm slides, 62 visuals         | \$ 5.30 |
| 240. MESA (IG 24)   | <i>Instructor Training.</i> 35mm Slides, 8 visuals                                                     | \$ 1.85 |
| 241. MESA (IG 25)   | <i>Job Safety Guide-Continuous Miner Operation.</i> 35mm Slides, 71 visuals                            | \$ 6.15 |
| 242. MESA (IG 26)   | <i>Job Safety Guide-Roof Bolting Operations.</i> 35mm Slides, 83 visuals                               | \$ 8.20 |
| 243. MESA (IG 27)   | <i>Job Safety Guide-Shuttle Car Operation.</i> 35mm Slides, 65 visuals                                 | \$ 5.75 |
| 244. MESA (IG 28)   | <i>Job Safety Guide-Trailing Cable Splicing.</i> 35mm Slides, 85 visuals                               | \$ 6.75 |
| 245. MESA (IG 29)   | <i>Portable Fire Extinguisher.</i> 35mm Slides, 69 visuals                                             | \$ 6.85 |
| 246. MESA (IG 30)   | <i>Rubber-Tired Front-End Loader and Fork Lift Truck Accident Prevention.</i> 35mm Slides, 123 visuals | \$12.05 |
| 247. MESA (IG 31)   | <i>CSE Permissible Digital Methanometer Model 100.</i> 35mm Slides, 15 visuals                         | \$ 1.40 |
| 248. MESA (IG 32C)  | <i>Job Safety Analysis Development.</i> 35mm Slides, 46 visuals                                        | \$11.50 |
| 249. MESA (IG 32D)  | <i>Safety Observations.</i> 35mm Slides, 26 visuals                                                    | \$ 6.50 |
| 250. MESA           | <i>First Aid Instruction Course.</i> 35mm Slides, 73 Visuals                                           | \$ 8.60 |
| 251. MESA (IG 2)    | <i>MSA W-65 Self-Rescuer.</i> Flip Charts, 3 pp.                                                       | \$ 7.90 |
| 252. MESA (IG 3)    | <i>Permissible Drager 810 Respirator for Self Rescue.</i> Flip Charts, 3 pp.                           | \$ 7.90 |
| 253. MESA (IG 6)    | <i>Permissible Methanometer G-70.</i> Flip Charts, 1 p.                                                | \$ 2.45 |
| 254. MESA (IG 7)    | <i>Permissible Methanometer M-402.</i> Flip Charts, 1 p.                                               | \$ 2.45 |
| 255. MESA (IG 8)    | <i>Permissible Methane Indicating Detector.</i> Flip Charts, 1 page                                    | \$ 2.45 |

Table IV — continued

| Source of Material:                                                                             | Title; Description:                                                                                                                    | Price:                                                                          |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| 256. MESA (IG 9)                                                                                | <i>MSA Permissible Methane Spotter. Flip Charts, 1 page</i>                                                                            | \$ 2.45                                                                         |
| 257. MESA (IG 2)                                                                                | <i>MSA W-65 Self-Rescuer. Posters, 1 p.</i>                                                                                            | \$ 1.90                                                                         |
| 258. MESA (IG 3)                                                                                | <i>Permissible Drager 810 Respirator for Self Rescue. Posters, 1 p.</i>                                                                | \$ 1.90                                                                         |
| 259. MESA (IG 6)                                                                                | <i>Permissible Methanometer G-70. Posters, 1 p.</i>                                                                                    | \$ 2.15                                                                         |
| 260. MESA (IG 7)                                                                                | <i>Permissible Methanometer M-402. Posters, 1 p.</i>                                                                                   | \$ 1.90                                                                         |
| 261. MESA (IG 8)                                                                                | <i>Permissible Methane Indicating Detector. Posters, 1 page</i>                                                                        | \$ 1.90                                                                         |
| 262. MESA (IG 9)                                                                                | <i>MSA Permissible Methane Spotter. Posters, 1 page</i>                                                                                | \$ 1.90                                                                         |
| 263. MESA (IG 2)                                                                                | <i>MSA W-65 Self Rescuer. Pocket Cards</i>                                                                                             | \$ 6.40/100                                                                     |
| 264. MESA (IG 3)                                                                                | <i>Permissible Drager 810 Respirator For Self Rescue. Pocket Cards</i>                                                                 | \$ 4.20/100                                                                     |
| 265. MESA (IG 2)                                                                                | <i>MSA W-65 Self Rescuer. Video Tapes, 22 minutes</i>                                                                                  | \$55.00                                                                         |
| 266. MESA (IG 3)                                                                                | <i>Permissible Drager 810 Respirator for Self Rescue. Video Tapes, 22 minutes</i>                                                      | \$55.00                                                                         |
| 267. MESA (IG 6)                                                                                | <i>Permissible Methanometer G-70. Video Tapes, 15 minutes</i>                                                                          | \$40.00                                                                         |
| 268. MESA (IG 8)                                                                                | <i>Permissible Methane Indicating Detector. Video Tape, approximately 15 minutes</i>                                                   | \$40.00                                                                         |
| 269. MESA (IG 9)                                                                                | <i>MSA Permissible Methane Spotter. Video Tape, 13 minutes</i>                                                                         | \$40.00                                                                         |
| 270. MESA                                                                                       | <i>Permissible Methanometer M-502. Video Tape, approximately 15 minutes</i>                                                            | \$40.00                                                                         |
| 271. Modern Talking Picture Service<br>2323 New Hyde Park Road<br>New Hyde Park, New York 11040 | • <i>An American Asset. 16mm Film-color, sound, 28 minutes (Borrower pays return postage)</i>                                          | Free-loan or Purchase at \$190.00 from Joy Mfg. Company                         |
| 272. National Coal Association<br>Available from Joy Mfg. Co.                                   | <i>The Invisible Power of Coal. 16mm Film-color, sound, 26 minutes</i>                                                                 | \$190.00                                                                        |
| 273. National Photographic Laboratories<br>BCOA/NCA<br>1926 West Gray<br>Houston, Texas 77019   | <i>Electrical Permissibility. 16mm Film-student workbook, instructor/trainer guide, criterion test</i>                                 | \$10.60 per student<br>One week's use of film for each student packet purchased |
| 274. National Photographic Laboratories, Inc.                                                   | <i>Electrical Test and Measurement Instruments. 16mm Film, student workbook, instructor/trainer's guide, criterion test</i>            | \$10.60 as above                                                                |
| 275. National Photographic Laboratories, Inc.                                                   | <i>Troubleshooting Hydraulic Systems. 1977, 16mm Film, student workbook, instructor/trainer's guide, criterion test</i>                | \$26.50 as above                                                                |
| 276. Prentice-Hall Media<br>Serv Code VE<br>150 White Plains Road<br>Tarrytown, N.Y. 10591      | <i>Basic Electric Arc Welding. Complete Set, 14 Color Super 8mm Film-loops VJH 2900</i>                                                | \$309.00                                                                        |
|                                                                                                 | <i>Each film loop</i>                                                                                                                  | \$26.00                                                                         |
| 277. Prentice-Hall Media                                                                        | <i>Oxyacetylene Welding. Complete Set, 4 Color filmstrips, 13 transparencies, 10 film loops and spirit masters, instructor's guide</i> | \$276.00                                                                        |

Table IV — continued

| Source of Material:                                                                         | Title; Description;                                                                                                                                              | Price:                                                                         |
|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| 278. United Mine Workers of America<br>900 Fifteenth Street, N.W.<br>Washington, D.C. 20005 | • <i>Proud To Be A Miner.</i><br>Slide-tape program, 140 slides                                                                                                  | \$150.00 large<br>organizations<br>\$75.00 Schools, UMW<br>locals, individuals |
| 279. West Virginia University<br>Mining Extension Service                                   | • <i>Barricading.</i> Slide-tape program, 61 slides                                                                                                              | \$90.00                                                                        |
| 280. West Virginia University<br>Mining Extension Service                                   | • <i>Escapeways.</i> Slide-tape program, 50 slides                                                                                                               | \$70.00                                                                        |
| 281. West Virginia University<br>Mining Extension Service                                   | • <i>Geology of Coal.</i><br>Slide-tape program, 58 slides                                                                                                       | In production                                                                  |
| 282. West Virginia University<br>Mining Extension Service                                   | • <i>An Introduction to Carbon Monoxide Gas.</i><br>Slide-tape program 40 slides                                                                                 | \$60.00                                                                        |
| 283. West Virginia University<br>Mining Extension Service                                   | • <i>Introduction to Underground Coal<br/>Mining Methods: Conventional and<br/>Continuous.</i> Slide-tape program,<br>45 slides                                  | \$65.00                                                                        |
| 284. West Virginia University<br>Mining Extension Service                                   | • <i>Introduction to Underground Coal<br/>Mining Methods: Longwall and<br/>Shortwall.</i> Slide-tape program, 45 slides                                          | \$65.00                                                                        |
| 285. West Virginia University<br>Mining Extension Service                                   | • <i>Mine Ventilation Controls and<br/>Their Mine Map Symbols.</i><br>Slide-tape program, 77 slides                                                              | \$115.00                                                                       |
| 286. West Virginia University<br>Mining Extension Service                                   | • <i>The MSA Carbon Monoxide Spotter.</i><br>Slide-tape program, 29 slides                                                                                       | \$45.00                                                                        |
| 287. West Virginia University<br>Mining Extension Service                                   | • <i>Overcasts and Undercasts.</i><br>Slide-tape program, 45 slides                                                                                              | \$65.00                                                                        |
| 288. West Virginia University<br>Mining Extension Service                                   | • <i>Safety Grounded Systems.</i>                                                                                                                                | \$90.00                                                                        |
| 289. West Virginia University<br>Mining Extension Service                                   | • <i>Shuttle Car Operation.</i><br>Slide-tape program, 33 slides                                                                                                 | \$50.00                                                                        |
| 290. John Deere Service Publications**<br>John Deere Road<br>Moline, Illinois 61265         | <i>Fundamentals of Service—20 Masters<br/>Electrical Systems.</i> (Transparency<br>Masters-190 masters on heavy 8½ x 11<br>sheets. Black and white with folder.) | \$21.00 Set                                                                    |
| 291. John Deere Service Publications**                                                      | <i>Fundamentals of Service-10 Masters<br/>Hydraulics.</i> (Transparency Master-<br>150 masters on heavy 8½ x 11 sheets.<br>Black and white with folder)          | \$16.50 Set                                                                    |
| 292. John Deere Service Publications**                                                      | <i>Fundamentals of Service-20: Slides,<br/>Electrical Systems.</i> (Slide set contains<br>295 slides in 35mm color in standard<br>2 x 2 in. frames)              | \$98.75                                                                        |
| 293. John Deere Service Publications**                                                      | <i>Fundamentals of Service-40: Masters,<br/>Power Trains.</i> (Transparency Masters-<br>130 masters on heavy 8½ x 11 sheets,<br>black and white with folder.)    | \$14.50 Set                                                                    |
| 294. John Deere Service Publications**                                                      | <i>Fundamentals of Service-10: Slides,<br/>Hydraulics.</i> Slide set contains 200 slides<br>in 35mm color in standard 2 x 2 in. frames                           | \$69.35 Set                                                                    |
| 295. John Deere Service Publications**                                                      | <i>Fundamentals of Service-40: Slides,<br/>Power Trains.</i> (Slide set contains 295<br>slides in 35mm color in standard 2 x 2<br>in. frames)                    | \$67.25 Set                                                                    |

Table IV — continued

| Source of Material:                                         | Title; Description:                                                                       | Price:  |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------|
| 296. West Virginia University**<br>Mining Extension Service | <i>Introduction to Underground Coal Mining.</i> Slide-tape program, 67 slides, 25 minutes | \$85.00 |
| 297. West Virginia University**<br>Mining Extension Service | <i>Introduction to Underground Blasting.</i> Slide-tape program, 65 slides, 25 minutes    | \$90.00 |
| 298. West Virginia University**<br>Mining Extension Service | <i>Introduction to Roof and Rib Control.</i> Slide-tape programs, 60 slides, 25 minutes   | \$95.00 |

\*\*Material arrived too late for alphabetical listing and cross referencing.

### Miscellaneous Resource Materials (Teacher and Student Reference Materials)

|                                                                                                                        |                                                                                                                                                |                                 |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| AMAX Coal Company<br>105 South Meridian Street<br>Indianapolis, Indiana 46225                                          | • <i>The Power of Coal</i> , (Booklet, 20 pp.)                                                                                                 | FREE                            |
| American Mining Congress<br>1100 Ring Building<br>Washington, D.C. 20036                                               | • <i>What Mining Means to Americans</i> , 1977, (Booklet, 16 pp.)                                                                              | FREE Single Copy                |
| American Technical Society<br>5608 Stony Island Avenue<br>Chicago, Illinois 60637                                      | <i>Fluid Power—Pneumatics</i> ,<br>by Olaf A. Johnson                                                                                          | List: \$10.65<br>School: \$7.99 |
| American Technical Society                                                                                             | <i>Fundamentals of Electricity</i> , 6th Ed.<br>by Robert G. Seippel                                                                           | List: \$9.10<br>School: \$6.83  |
| American Technical Society                                                                                             | <i>Welding Technology</i> , 2 Ed. by Joseph<br>W. Giachino, and Others                                                                         | List: \$9.90<br>School: \$7.43  |
| Charles A. Bennett Co., Inc.<br>809 West Detweiller Drive<br>Peoria, Illinois 61614                                    | <i>Exploring Power Mechanics</i> , 119-2<br>by Harold T. Glenn                                                                                 | List: \$8.48<br>School: \$6.36  |
| Charles A. Bennett Co., Inc.                                                                                           | <i>Exploring Power Mechanics Workbook</i> ,<br>(includes Related Math)                                                                         | List: \$1.40<br>School: \$1.05  |
| Coal Age Mining Informational Services<br>McGraw-Hill, Inc.<br>1221 Avenue of the Americas<br>New York, New York 10020 | • <i>COAL AGE Operating Handbook of Underground Mining</i> , Vol. 1, 1977.<br>(Hardcover, 410 pp.) Compilation of<br>articles on mining topics | \$19.50                         |
| Coal Mine Training Materials, Inc.<br>6548-A Roosevelt Avenue, S.E.<br>Charleston, West Virginia                       | • <i>Mine Foreman's Final Exam</i><br>(Softcover, 114 pp.)                                                                                     | \$ 5.25 each                    |
| Coal Mine Training Materials, Inc.                                                                                     | • <i>Mine Foreman Study Guide</i><br>(Softcover, 232 pp.)                                                                                      | \$ 5.25 each                    |
| Coal Mine Training Materials, Inc.                                                                                     | • <i>Mine Foreman's Workbook</i><br>(Oversize, Softcover 260 pp.)                                                                              | \$ 5.00                         |
| Coal Mine Training Materials, Inc.                                                                                     | • <i>Underground Coal Mine Safety Laws</i><br>for the State of West Virginia<br>(Softcover, 91 pp.)                                            | \$ 1.70 each                    |
| EXXON Corporation<br>The Carter Oil Company                                                                            | • <i>Coal and EXXON</i> , 5/77 (Booklet, 11 pp.)                                                                                               | FREE                            |
| EXXON Corporation                                                                                                      | • <i>Coal—Energy Bridge to the Future</i> ,<br>November, 1977 (Booklet, 35 pp.)                                                                | FREE                            |
| Field Enterprises Education Corp.<br>Merchandise Mart Plaza<br>Chicago, Illinois 60654                                 | • <i>COAL</i> , reprint of an article from the<br>World Book encyclopedia, 1976 (22 pp.)                                                       | FREE                            |

Table IV — continued

| Source of Material:                                                                            | Title; Description:                                                                                                                                                                                                                              | Price:           |
|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| General Accounting Office of the United States                                                 | <ul style="list-style-type: none"> <li>• <i>U.S. Coal Development—Promises, Uncertainties</i>; Report to the Congress by the Comptroller General of the United States, Sept. 22, 1977</li> </ul>                                                 | FREE             |
| The Pennsylvania State University School of Mineral Industries Extension Services              | <ul style="list-style-type: none"> <li>• <i>Coal Mining</i>, Volume II, Third Edition by Donald C. Jones and Joseph W. Hunt, 1952 (Hard cover text, 363 pp.)</li> </ul>                                                                          | \$10.00          |
| The Pennsylvania State University University Park, Pennsylvania                                | <ul style="list-style-type: none"> <li>• <i>Hydraulics in Mining Equipment</i>, Part 1, Second Edition, 1968 (Softcover text, 283 pp.)</li> </ul>                                                                                                | \$ 5.00          |
| Illinois State Geological Survey National Resources Building Urbana, Illinois 61801            | <ul style="list-style-type: none"> <li>• <i>Directory of Illinois Mineral Producers</i>, 1974 compiled by Ramesh Malhotra and Portia A. Smith, Illinois Minerals Note 64, July 1976, (119 pp.)</li> </ul>                                        | FREE             |
| Illinois State Geological Survey                                                               | <ul style="list-style-type: none"> <li>• <i>Factors Responsible for Variation in Productivity of Illinois Coal Mines</i>, Illinois Minerals Note 60 by Ramesh Malhotra, Aug. 1975, (18 pp.)</li> </ul>                                           | FREE             |
| Illinois State Geological Survey                                                               | <ul style="list-style-type: none"> <li>• <i>Illinois Coal: Development Potential</i>, Illinois Minerals Note 65, Nov. 1976, by Ramesh Malhotra and Jack A. Simon (20 pp.)</li> </ul>                                                             | FREE             |
| Illinois State Geological Survey                                                               | <ul style="list-style-type: none"> <li>• <i>Illinois Mineral Industry in 1975</i>, Illinois Minerals Note 68, Dec. 1977, by Irma Samson and Amy Dingwell, (39 pp.)</li> </ul>                                                                    | FREE             |
| Illinois State Geological Survey                                                               | <ul style="list-style-type: none"> <li>• <i>Market Potential For Coals of the Illinois Basin</i>, Illinois Minerals Note 67, August 1977 by Ramesh Malhotra, (60 pp.)</li> </ul>                                                                 | FREE             |
| National Coal Association Education Division 1130 Seventeenth St., N.W. Washington, D.C. 20036 | <ul style="list-style-type: none"> <li>• <i>Coal Facts</i>—1974-1975 Edition (95 pp.) 1978 Edition (95 pp.)</li> </ul>                                                                                                                           | \$ 5.00 each     |
| National Coal Association                                                                      | <ul style="list-style-type: none"> <li>• <i>Coal in Today's World</i>, 1974 Edition. (booklet, 19 pp.)</li> </ul>                                                                                                                                | FREE             |
| National Coal Association                                                                      | <ul style="list-style-type: none"> <li>• <i>Implications of Investments in the Coal Industry By Firms from Other Energy Industries</i>—Sources: Survey of NCA Members, McGraw-Hill Keystone Industry Manual, and U.S. Bureau of Mines</li> </ul> | FREE             |
| State of Illinois Department of Mines and Minerals Springfield, Illinois                       | <ul style="list-style-type: none"> <li>• <i>Annual Coal, Oil and Gas Report</i>, 1975 (82 pp.)</li> </ul>                                                                                                                                        | FREE             |
| State of Illinois                                                                              | <ul style="list-style-type: none"> <li>• <i>The Coal Mining Act</i>, Revised Edition September, 1975 (132 pp.)</li> </ul>                                                                                                                        | FREE             |
| State of Illinois                                                                              | <ul style="list-style-type: none"> <li>• <i>First-Aid and Mine Rescue Manual</i>, (Softcover, 40 pp.)</li> </ul>                                                                                                                                 | FREE             |
| State of Illinois                                                                              | <ul style="list-style-type: none"> <li>• <i>Handbook for the New Illinois Coal Miner</i>, (Softcover, 165 pp.)</li> </ul>                                                                                                                        | FREE             |
| State of Illinois                                                                              | <ul style="list-style-type: none"> <li>• <i>Hoisting Manual</i>, 1975 (Softcover, 16 pp.)</li> </ul>                                                                                                                                             | FREE             |
| State of Illinois                                                                              | <ul style="list-style-type: none"> <li>• <i>Practical Mining Manual</i> by Jayne Talbott 5/73 (Softcover, 63 pp.)</li> </ul>                                                                                                                     | FREE             |
| TEXACO, Inc. 135 East 42nd St. New York, New York                                              | <ul style="list-style-type: none"> <li>• <i>Lubrication</i>, Volume 53, 1967 Number 7, Mining Machinery I (Hardcover, 12 pp.)</li> </ul>                                                                                                         | FREE (Back copy) |

Table IV — continued

| Source of Material:                                                                                                                                            | Title; Description:                                                                                                                                                                                                                                         | Price:           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| TEXACO, Inc.                                                                                                                                                   | • <i>Lubrication</i> , Volume 52, 1967 Number 8 Mining Machinery II (12 pp.)                                                                                                                                                                                | FREE (Back copy) |
| TEXACO, Inc.                                                                                                                                                   | • <i>Lubrication</i> , Volume 53, 1967 Number 9, Mining Machinery III (12 pp.)                                                                                                                                                                              | FREE (Back copy) |
| The Pennsylvania State University<br>Department of Mineral Engineering<br>University Park, Pa.                                                                 | • <i>Questions and Answers</i> , Examination of Applicants for Certificates of Qualification as Mine Foreman, Assistant Mine Foreman, Electricians and Fire Bosses in the Bituminous Coal Region of Pennsylvania, 1975 (47 pp.)                             | \$ 2.00          |
| United Mine Workers of America<br>900 Fifteenth Street, N.W.<br>Washington, D.C. 20005                                                                         | • <i>A Brief History of the United Mine Workers of America</i> by Justin McCarthy, Editor, UMW Journal, (Booklet, 18 pp.)                                                                                                                                   | FREE             |
| United Mine Workers of America                                                                                                                                 | • <i>It's Your Union Pass It On</i> , Officers' Report to the United Mine Workers of America 47th Constitutional Convention, 1976, (105 pp.)                                                                                                                | FREE             |
| United Mine Workers of America/<br>Bituminous Coal Operator's Assn.                                                                                            | • <i>National Bituminous Coal Wage Agreement of 1978</i>                                                                                                                                                                                                    | FREE             |
| University of Illinois at Urbana<br>Champaign-Division of Business<br>Education, Department of Vocational<br>and Technical Education<br>Urbana, Illinois 61801 | • <i>Methods and Materials for Teaching Occupational Skills</i> , Loose-leaf notebook containing 12 instructional modules                                                                                                                                   |                  |
| U.S. Congress<br>Public Law 91-173                                                                                                                             | • <i>Federal Coal Mine Health and Safety Act of 1969</i>                                                                                                                                                                                                    | FREE             |
| U.S. Congress<br>Public Law 95-164<br>95th Congress—Nov. 9, 1977                                                                                               | • <i>Federal Mine Safety and Health Amendments Act of 1977</i>                                                                                                                                                                                              | FREE             |
| U.S. Department of Energy<br>Washington, D.C. 20545                                                                                                            | • <i>Fossil Energy Technical Manpower: Forecasts of Supply and Demand</i> prepared by Bernard S. Friedman, Consultant for the Acting Director of University Programs for DOE (Formerly called ERDA-Fossil Energy) October, 1975, (Softcover report, 42 pp.) | FREE             |
| U.S. Department of Energy                                                                                                                                      | • <i>Manpower for Coal Mining, Supply-Demand-Training</i> . Prepared for Division of Materials and Exploratory Research, ERDA-Fossil Energy by Bernard S. Friedman, Consultant, September, 1977, (Softcover report, 73 pp.)                                 | FREE             |
| U.S. Department of the Interior<br>Bureau of Mines<br>Superintendent of Documents<br>Washington, D.C. 20402                                                    | <i>A Dictionary of Mining, Mineral, and Related Terms</i>                                                                                                                                                                                                   | \$21.05          |
| U.S. Department of the Interior<br>Bureau of Mines<br>4800 Forbes Avenue<br>Pittsburgh, Pa. 15213                                                              | • <i>Fires, Gases, and Ventilation in Metal and Non-Metallic Mines</i> , Miners' Circular 55, Metal and Non-Metallic Mine Accident Prevention, Course-Section 5, Revised January, 1955, (Booklet, 124 pp.)                                                  | FREE             |

Table IV — continued

| Source of Material:                                                                                          | Title; Description:                                                                                                                                                                                   | Price:                                                             |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| U.S. Department of the Interior<br>Bureau of Mines                                                           | • <i>Instruments for Detecting Gas in Underground Mines and Tunnels</i> , Bureau of Mines Information Circular 8548, 1972 by B.I. Ferber and A.H. Wieser (16 pp.)                                     | FREE                                                               |
| U.S. Department of the Interior<br>Bureau of Mines                                                           | • <i>Introduction to Mine Ventilation Principles and Practices</i> , Bureau of Mines Bulletin 589, by D.S. Kingery, 1960, (54 pp.)                                                                    | FREE                                                               |
| U.S. Department of the Interior<br>Bureau of Mines<br>Mining Enforcement and Safety<br>Administration (MESA) | • <i>Title 30, Code of Federal Regulations Parts 75 &amp; 77</i>                                                                                                                                      | FREE                                                               |
| U.S. Department of the Interior<br>U.S. Geological Survey                                                    | • <i>Coal Resources of the United States, January 1, 1974</i> , Geological Survey Bulletin 1412, by Paul Averitt (131 pp.)                                                                            | \$ 1.60                                                            |
| Westinghouse Electric Corporation<br>Printing Division<br>Trafford, Pa. 15085                                | • <i>Westinghouse Electrical Maintenance Hints</i> , 3rd Printing, Sept. 1976 (Hardcover reference book)                                                                                              | \$23.45                                                            |
| West Virginia Coal Association<br>P.O. Box 1111<br>Charleston, West Virginia                                 | • "COAL, The 500 Year Career", A Look At Changing Times and New Employment Opportunities for West Virginians (Booklet, 10 pp.)                                                                        | FREE                                                               |
| West Virginia Geological And<br>Economic Survey<br>Morgantown, West Virginia                                 | • <i>Coal and Coal Mining in West Virginia</i> (Softcover booklet, 62 pp.)                                                                                                                            | FREE                                                               |
| West Virginia University<br>Mining Extension Service                                                         | • <i>West Virginia Mine Foreman Certification Examination</i> , No. 12, Study Guide Series, (152 pp.)                                                                                                 |                                                                    |
| Admiral Peary Vocational-Technical School<br>Ebensburg, Pa. 15931                                            | • <i>Mining Careers—Instructor's Manual and Student's Basic Course of Study</i> (only examples—all of course not included) See page 25 of document for other modularized instructional program areas. | FREE (Full program will be available for purchase at a later date) |
| West Virginia—McDowell County<br>Vocational Technical Center Mining Campus                                   | • <i>Coal Miner Training Program for Twelfth Grade Students—Course Outline</i>                                                                                                                        |                                                                    |
| Joy Manufacturing Company                                                                                    | • <i>Super MiniLabs Electric Motor Kit</i>                                                                                                                                                            | \$ 2.50                                                            |
| Joy Manufacturing Company                                                                                    | • <i>Hydraulic Pump Kit</i> by MiniLabs                                                                                                                                                               | \$ 2.50                                                            |
| National Coal Association                                                                                    | • <i>Buried Sunshine—The Story of Coal</i> (Coal samples and information booklet, 8 pp.)                                                                                                              | FREE—Single Copy                                                   |
| MESA                                                                                                         | • <i>Job Safety Analysis—Safety Manual No. 5</i> , (31 pp.)                                                                                                                                           | FREE                                                               |
| McDonnell-Douglas Astronautics Company                                                                       | • <i>Safety Task Analyses of Underground Miners of West Virginia</i> , 10 October, 1974 to 21 January, 1975, (Mimeographed material, 103 pp.)                                                         | FREE                                                               |

Table IV — continued

Periodicals Pertaining to Coal Mining\*

- BLACK DIAMOND, THE (Monthly)  
343 Dearborn Street  
Chicago, Illinois 60604
- COAL AGE (Monthly)  
McGraw-Hill, Inc.  
1221 Avenue of the Americas  
New York, New York 10020
- COAL DAILY (Daily)  
Casey Publishing Company  
1063 National Press Bldg.  
Washington, D.C. 20045
- COAL INDUSTRY NEWS (Bi-Weekly)  
Gordon Publications, Inc.  
20 Community Place  
Morristown, New Jersey 07960
- COAL MINING AND  
PROCESSING (Monthly)  
Maclean-Hunter Publishing Company  
300 West Adams Street  
Chicago, Illinois 60606
- COAL OUTLOOK (Weekly)  
Observer Publishing Company  
1053 31st Street, N.W.  
Washington, D.C. 20007
- COAL PATROL (Monthly)  
Brophy Associates  
1028 Connecticut Avenue  
Washington, D.C. 20036
- COAL WEEK (Weekly)  
McGraw-Hill, Inc.
- KEYSTONE COAL INDUSTRY  
MANUAL (Annual)  
McGraw-Hill, Inc.
- MINE PRODUCTIVITY  
REPORT (Weekly)  
McGraw-Hill, Inc.
- MINING CONGRESS  
JOURNAL (Monthly)  
American Mining Congress  
1100 Ring Building  
Washington, D.C. 20036
- MINING ENGINEERING (Monthly)  
Society of Mining Engineers of AIME  
540 Arapahoe Drive  
Box 8800  
Salt Lake City, Utah 84108
- UNITED MINE WORKERS  
JOURNAL  
900 15th Street, N.W.  
Washington, D.C. 20005
- WORLD COAL (Monthly)  
500 Howard Street  
San Francisco, Calif. 94105

Coal Coverage in Energy Periodicals:

- CAPITAL ENERGY LETTER (Weekly)  
National Press Building  
Washington, D.C. 20045
- ENERGY DAILY, THE (Daily)  
300 National Press Building  
Washington, D.C. 20045
- OIL DAILY (Daily)  
320 Campus Drive  
Somerset, New Jersey 08873

\*Periodical listing supplied by National Coal Association

# # #

## PROCEDURES FOR USE

Four tables have been developed in the course of this project. This section outlines a step-by-step process for utilizing the four tables to aid in the planning of secondary level coal mining curricula in the State of Illinois.

### Step 1: Identify competencies to be included in the coal mining curriculum

Several important factors will need to be considered by school district personnel during the selection of competencies for inclusion in a coal mining curriculum.

- First, the district should identify the needs of local mining companies for new miners, and the competencies which those miners should possess.
- Secondly, the district will need to identify the resources which are available to support a coal mining curriculum.
- Finally, the district will need to determine the number of instructional contact hours which will be included in the curriculum.

A Mining Curriculum Advisory Committee could be extremely valuable in identifying the needs of local mining companies for new miners and the competencies which those miners should possess. The involvement of local mine personnel in an advisory capacity will help to ensure that the training provided to students is consistent with local hiring preferences or requirements. It can also serve to facilitate the future placement of students into mining occupations.

Resources available to the school district will have a definite impact on the structure of the curriculum. An assessment of instructional staff, facilities and equipment available at the school will help in determining the competencies which students could acquire. If an Advisory Committee is involved in this process, it might be possible to supplement school resources with equipment contributed by the mining companies. Staff capabilities might be supplemented by lectures or demonstrations from mining personnel.

The breadth and depth of competencies appropriate for inclusion in the curriculum will also be influenced by the amount of instructional time available. During the selection of competencies for inclusion in the curriculum, the time required to teach the competencies will need to be considered in light of the total instructional time available.

Table I presents the first product of this project: a listing of occupational competencies ranked in order of importance for inclusion in secondary level coal mining

curricula. Competencies can be considered the building blocks of the curriculum and as such should be chosen with careful deliberation. The listing of ranked competencies can provide a valuable input into discussions between curriculum planners and an Advisory Committee concerning the selection of competencies.

Discussion of the groupings of competencies according to their rankings of major importance, of moderate importance, and of little or no importance for entry-level miners can provide a starting point for the dialogue between curriculum planners and Advisory Committee members. Competencies receiving 'major' or 'moderate' importance ratings may receive first consideration for inclusion in a secondary curriculum, but those competencies whose ratings are in the 'little or no importance' range can also be included in the discussion. In an attempt to consider and reflect local conditions, needs and constraints, priorities for the teaching of competencies may need to be reordered. In the process of reviewing the competencies presented in Table I, Advisory Committee members and curriculum planners will need to select the specific competencies most appropriate for inclusion in the curriculum. The final ordering or ranking of competencies should reflect those competencies which local mining companies consider important for entry-level miners to possess.

Once the important competencies have been identified and ranked, further discussions should focus on the resources needed and available for providing appropriate instruction. Each of the important competencies should be considered in light of the instructional skills, equipment and facilities necessary for providing instruction. These should then be reviewed with regard to resources available at the school or from local mining companies. This process should result in the identification of a set of important competencies for which instruction could be provided with available resources.

Consideration will then need to be given to the amount of time required to teach students the competencies, which will depend on the nature of the competencies, the level of instruction needed, and the anticipated qualifications of students. Advisory Committee members may be able to provide estimates of the instructional time needed, and school personnel can temper those estimates based on their knowledge of student characteristics. By comparing the cumulative time estimates with the amount of time available for instruction, the specific competencies to be included in the full curriculum will be identified. The first step in the curriculum planning process will be completed. At that point, instructional material appropriate for teaching the competencies will need to be identified. The procedures for identifying appropriate instructional materials are described in Step 2.

## Step 2: Identify instructional materials available for use in teaching the competencies selected in Step 1

Step 2 is the identification of instructional/training materials that can be used to teach the competencies selected in Step 1. This identification process involves the use of the competency-to-materials match presented in Table II and the inventory of instructional materials in Table IV.

There are several considerations curriculum planners will want to take into account before beginning the process of identifying materials best suited for teaching the chosen competencies. One consideration is that of the **preferred or primary instructional mode to be used** in the teaching of the competencies, e.g., single teacher, team of teachers, independent study, etc. Another consideration involves **methods or techniques to be used** in instructing students, e.g., lecture, discussion, demonstration, field trip, problem solving, lab or shop work, programmed instruction, or a combination of several of the above. Some types of materials lend themselves more easily to certain modes or methods, e.g., problem-solving and practice — workbooks; or student reading assignments — textbooks or reference materials.

Closely tied to the mode and methods of instruction is the consideration of **how much teacher involvement/support a certain type of material requires**. Independent study would, for instance, take less teacher involvement than would lecture and demonstration.

**Materials may be needed for differing purposes** such as lecture preparation and delivery, student reading or completion assignments, and as supplementary information to introduce, support, or further explain competency presentation (e.g., films, slide-tape programs, etc.). Knowing the purpose for which the materials are intended is another aid to their identification.

**The estimated length of time considered necessary to teach competencies** will also influence the identification and ultimate selection of materials. For a competency allotted one week for coverage, a 400-page textbook is likely to provide too detailed a study. On the other hand, some competencies could require more time and consequently a more in-depth presentation of material.

Having taken into account the considerations discussed above, planners can proceed with the identification of materials with some conceptions of the types of materials needed, the depth of coverage required and the purpose for which the materials are intended. However, they also need to know the organization of Table IV as it has been designed to aid their efforts.

Table IV presents instructional/training materials grouped into:

- 1) those primarily for classroom/student use;
- 2) those classified as audio-visual aids;
- 3) those considered mainly as student and teacher reference materials, and
- 4) miscellaneous materials relating to coal and miner training.

Instructional materials numbered from 1-100 are those classified as textbooks, workbooks, data sheets, handbooks, manuals, practice maps, etc. Numbers 101-298 represent audio-visual aids including films, slide-tape programs, video cassette programs, transparencies, charts, posters, pocket cards, etc. The last two groupings of materials, are not numbered because they are not included in the competency-to-materials match. Some of these materials may not relate directly to entry-level coal mining competencies. Others may not be designed primarily for classroom use. Still others are written above a secondary reading level. However, these materials can prove valuable as supplementary information or reference sources for teachers or students in a secondary mining curriculum.

As each competency is considered, the aforementioned points such as instructional mode/method, level or depth of instruction required, purpose for which the material is intended, etc. should be kept in mind. Then by noting the number representing the matched instructional material, the general type of grouping of the materials can be determined (See Figure 4).

If the number representing the instructional material falls within the range from 1-100, and the need is for classroom instructional material, the curriculum planner will locate the material number listed in Table IV and consider the information provided concerning the material in question. For example, suppose the competency was matched to Number 1. Number 1 of Table IV is *Elements of Practical Coal Mining*, a hardcover textbook containing 614 pages. If the need, intended purpose, method of instruction, etc. are taken into account and this material is deemed appropriate, then Number 1 in Table II could be circled to indicate that this instructional material should be given further consideration. The entire procedure would then be repeated for subsequent instructional materials.

If, on the other hand, a competency is matched to a number between 101 and 298, the planner will know that

an audio-visual aid is involved. If the competency instruction method, purpose, or level of instruction required are not compatible with use of an audio-visual aid, the material can be eliminated from further consideration.

By following the procedures outlined above, curriculum planners can identify a tentative selection of relevant instructional materials for the teaching of each previously chosen competency. Prior to making the final choices of materials, however, there are several further considerations outlined in Step III that can aid in making the decisions as to which materials to purchase.

**Figure 4. Instructional/Training Materials in Table IV**

| Number of Material                                                                  | Type of Material                                                                                                                                                                       |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-100                                                                               | Textbooks, workbooks, data sheets, handbooks, manuals, practice maps, etc. primarily for in-classroom student use.                                                                     |
| 101-298                                                                             | Audio-visual aids such as: films, slide-tape programs, video-cassette programs, transparencies, charts, posters, pocket cards, etc.                                                    |
| Unnumbered<br>Miscellaneous<br>Materials for<br>Teacher and<br>Student<br>Reference | Includes resources such as: encyclopedia articles, dictionary of mining terms, legislation concerning coal mining, geological reports, State and Federal agency mining documents, etc. |
| Periodicals<br>Pertaining to<br>Coal Mining                                         | Daily, weekly, monthly and annual publications dealing with coal mining topics.                                                                                                        |

### **Step 3. Match instructional/training materials to competencies they cover in order to determine which materials are best suited for teaching of the competencies identified in Step 1**

Step 3 is the determination of which instructional/training materials tentatively identified in Step 2 are best suited for teaching the competencies chosen for inclusion in a secondary level coal mining curriculum. In order to facilitate this determination, planners can use Table III, which provides a materials-to-competency match. This match reveals the **scope of competency coverage** for each instructional material listed.

Table III lists instructional materials by title followed by numbers representing each competency on which relevant information is given. The reader will note that Table III contains a reversal of the information presented in Table II and has a different purpose. Whereas Table II showed how many and which materials contained information relevant to each competency listed, Table III shows how many competencies are covered in each separate instructional material.

One benefit of Step 3 is that it provides yet another decision dimension — scope of competency coverage by each individual instructional/training material — for consideration before final choices of instructional materials are made. The important observation to be made, of course, is how well the material covers those competencies chosen in Step 1.

The type of curriculum being developed, (e.g., basic introductory coal mining study including broad coverage of a large number of competencies vs. in-depth concentration on a limited number of mining skills) will influence these considerations of the scope of instructional materials greatly. In one instance, there may be need for textbooks or other materials which include many of the chosen competencies but do not contain in-depth coverage of any. In another instance, there may be need for instructional materials, each of which provides in-depth coverage of one or a few related competencies chosen for inclusion in the curriculum.

One possible procedure for using Table III is to circle the number of each chosen competency wherever it appears (either under the Knowledges/Understandings column or the Abilities/Skills column) in Table III. Following this process, the coverage of the chosen competencies will become apparent, and further decisions can be made for inclusion or elimination of materials based on the need for broad coverage of many competencies by the material or in-depth coverage on one or a few competencies.

The result of Step 3 will be the provision of a carefully determined listing of apparently acceptable instructional/training materials chosen for in-person review, selection and purchase.

### **Step 4. Make final selection of instructional/training materials to be used in the secondary level coal mining curriculum for entry-level miners**

The optimal method for final selection of instructional/training materials for the coal mining curriculum is in-person review of those materials identified in Step 2 and considered further and tentatively chosen in Step 3. The experience of seeing sample copies of textbooks, workbooks, programmed instruction materials, etc. and of being able to preview films, slide-tape programs, and other audio-visual aids, can never be equalled by making

choices sight unseen. Visual inspection of materials gives the curriculum planner or instructor the opportunity to see the format of the material, to estimate the reading level required, to make judgments as to whether the material is too complex or at too high an instructional level, to determine if coverage or depth of competency presentation is appropriate for curriculum needs and time constraints, and to decide if the material is compatible with goals of instruction, as determined by local planners.

If an in-person review cannot be arranged, the best procedure for identifying instructional/training materials is to follow the steps outlined above and use the information in previous steps and in Table IV to make the most carefully considered choices possible.

Some of the information provided by Table IV was used earlier in the process of identification of potentially useful materials. In Step 4, that information, including

the title, type of material, (e.g., textbook, manual, slide-tape program), number of pages, etc. should be reviewed and any additional information noted. The cost of the materials is, of course, an important decision factor. The foregoing procedures for assuring the best coverage of chosen competencies will help to make clear whether, for the purpose of this curriculum, the material is worth the cost.

By following the four steps described above, local educational agencies will be able to plan and develop coal mining curricula which are in accord with local needs and resources. The resulting curricula will be designed to provide students with the particular competencies which are most important for entry-level miners in their geographic area. The procedures will be of considerable assistance to instructional staff in identifying instructional materials which are most appropriate in light of the competencies they wish their students to develop.

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